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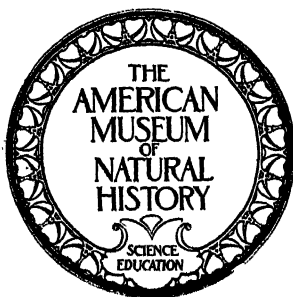




# AMERICAN MUSEUM NOVITATES

NUMBERS 822 to 898

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NEW YORK  
PUBLISHED BY ORDER OF THE TRUSTEES  
1936



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The edition of Novitates is 1000. Copies are mailed on the date of issue, and the remainder of the stock is placed on sale in the Library.

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## ERRATA

- No. 854 After this paper went to press, P. Teilhard de Chardin called attention to the fact that the name *Stephanoceras* is preoccupied by *Stephanoceras* Waagen, 1869, a cephalopod. Therefore the name *Stephanoceras* as used in this present paper is to be replaced by *Stephanocemas*. *στέφανος*—a crown; *κεμας*—a young deer. *Stephanocemas thomsoni* is the generic type.—EDWIN H. COLBERT.
- “ 886. Page 7, caption for Fig. 6: for *parastictus* read *magdalinus*.
- “ 887. Page 1, last line of first paragraph: for he has given read which he gave.

# AMERICAN MUSEUM NOVITATES

Number 822

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

March 9, 1936

56.9 32 C (118:7)

## THE CRICETID RODENTS DESCRIBED BY LEIDY AND COPE FROM THE TERTIARY OF NORTH AMERICA

By ALBERT ELMER WOOD

In the course of studying the fossil Cricetids of North America in an attempt to unravel their evolution, it was immediately obvious that very little progress could be made until the original type specimens had been restudied and refigured, due to the inadequate nature of the original figures and descriptions of these small rodents. An opportunity to study these fossils was presented while I was Cutting Traveling Fellow in Columbia University. This study was further assisted by a grant from the Marsh Fund of the National Academy of Sciences. I wish to express my thanks to the authorities of the American Museum of Natural History, the United States National Museum, and The Philadelphia Academy of Natural Science for permission and facilities to study these specimens. The illustrations are by the author.

### *Eumys elegans* Leidy, 1856

Figure 1, and Leidy, 1869, Pl. xxvi, figs. 12-13

GENOHOLOTYPE.—Acad. Nat. Sci. Phila. No. 11027, left mandible with  $M_2$ , part of  $M_1$ , and alveolus of  $M_3$ .

HORIZON AND LOCALITY.—Middle Oligocene Brule of South Dakota.

DIAGNOSIS.— $M_2$  quadrate, longer than broad; anterior cingulum continuous across whole front of tooth, with subequal buccal and lingual moities; posterior arm of protoconid free from both metaconid and entoconid, reaching almost to lingual margin of the tooth; central cusp small, with no lingual crest and very weak buccal one; hypoconulid apparently reduced; posterior cingulum reaching entoconid upon wear.

The characters as listed above are found in a considerable number of the Oligocene rodents hitherto referred to this species, though by no means in a majority. The specimen figured by Schaub (1925, Pl. II, fig. 16) is distinguished from *E. elegans* by the shortness of the posterior arm of the protoconid, by the well-developed buccal crest of the central cusp, and by a slight difference in the shape of the tooth, the posterior half being slightly buccad of the anterior. This last difference seems of little importance, but the first two would probably warrant specific sepa-

ration, when taken together with the differences doubtless existing in the rest of the animal. A consideration of this question, as well as of the phylogenetic position of *E. elegans*, is reserved for a future study. According to Schaub's interpretation of the phylogenetic sequence of Cricetids, however (Schaub, 1925), the small size of the central cusp (Schaub's "mesostylid"), and particularly the absence of the lingual crest of the central cusp (Schaub's "mesostylidsporn"), together with the length of the posterior arm of the protoconid, would be progressive characters, indicating advances over the conditions found in the most primitive forms of *Cricetodon*. The feature in which this genus is most clearly separated from *Cricetodon* is in the length of the posterior arm of the protoconid, which is longer than the lingual crest of the central cusp, a condition never seen in *Cricetodon* (Schaub, 1925).

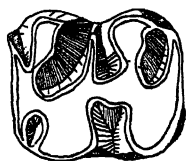


Fig. 1

Acad. Nat. Sci. No. 11027



Fig. 2

A.M.N.H. No. 7018



Fig. 3

A.M.N.H. No. 7028



Fig. 4

A.M.N.H. No. 7022



Fig. 5

U.S.N.M. No. 1204

Fig. 1. *Eumys elegans*, Leidy. Holotype,  $M_2$  left,  $\times 10$ . Acad. Nat. Sci. Phila., No. 11027.

Fig. 2. *Leidymys nematodon* (Cope). Holotype,  $M_1^{-3}$  left,  $\times 5$ . A.M.N.H. No. 7018.

Fig. 3. *Leidymys lockingtonianus* (Cope). Holotype,  $M_1^{-3}$  right, reversed,  $\times 5$ . A.M.N.H. No. 7028.

Fig. 4. *Paciculus insolitus* Cope. Holotype,  $M_1^{-3}$  right, reversed,  $\times 5$ . A.M.N.H. No. 7022.

Fig. 5. *Copemys lozodon* (Cope). Holotype,  $M_{1-2}$  right,  $\times 5$ . U.S.N.M. No. 1204.

## LEIDYMYNS, NEW GENUS

GENOTYPE.—*Hesperomys nematodon*, Cope, 1879, a species represented by a skull with the cheek teeth, from the Upper Oligocene Middle John Day Beds of Oregon.

DIAGNOSIS.—Skull roof flat, with temporal crests widely spaced, and showing no signs of convergence, as is the case in *Eumys*;  $M^{1-2}$  not essentially different from those of *Eumys*;  $M^3$  large, with well-developed hypocone, posterior cingulum, and exceptionally large central cusp and associated crests.

SPECIES.—*Leidymys nematodon* (Cope) and *L. lockingtonianus* (Cope), both from the Middle John Day.

*Leidymys nematodon* (Cope), 1879

Figure 2, and Cope, 1885, Pl. LXVI, figs. 33-33a

*Hesperomys nematodon* Cope, 1879.

*Eumys nematodon* (Cope), Cope, 1881a.

*Hesperomys nematodon* Cope, Cope, 1881c.

*Peromyscus nematodon* (Cope), Hay, 1902.

HOLOTYPE.—A.M.N.H. No. 7018.

HORIZON AND LOCALITY.—Upper Oligocene Middle John Day Beds of the John Day River, Oregon.

DIAGNOSIS.—Skull top with broad level area between temporal crests; cusps of molars rounded as in *Eumys*; two crests from protocone to anterocone of  $M^1$ ; central cusp indistinct, with well-developed buccal crests, which do not, however, reach the buccal margin of the tooth except on  $M^3$ ; cingula complete on all teeth; slight dams across median valleys of  $M^{1-2}$ .

This species is clearly distinct from skulls which may unhesitatingly be referred to *Eumys*, on the basis of the skull top and the third upper molar. No specimen of *Eumys* with which I am familiar shows anything except the simple sagittal crest, whereas this form has paired temporal crests extending well behind the orbit, which never unite to form a sagittal crest but remain as clearly defined ridges following the superior border of the orbit. This cannot be an age character, as the type of *L. nematodon* has fairly well-worn teeth, and specimens of *Eumys* with much less worn teeth have quite different arrangement of the crests. Nor can it be a sexual difference, as it seems most unlikely that one sex should be found only in Oregon, while the other was found throughout the Great Plains deposits.

The type of  $M^{1-2}$  falls within the range of variation that might be allowable for *Eumys*, the distinctions that could be made being probably of no more than specific value. In  $M^3$ , however, the two genera are quite distinct.  $M^3$  of *Leidymys* has a well-developed hypocone, though it is smaller than in the first two molars. This cusp is either absent or essentially aborted in the third molar of *Eumys*. In connection with this, the lingual valley of  $M^3$  in *Eumys* runs anterad as in  $M^{1-2}$ , whereas

in *Leidymys* it is directed posterad. The central cusp of this tooth is also very well developed, sending a crest to the postero-external margin of the tooth. There is thus some similarity between  $M^3$  of *L. nematodon* and that of *Plesiosminthus myarion* (Schaub, 1930, Fig. 6). The upper incisors of *L. nematodon* are smooth and rounded, though not as round as in specimens referable to *Eumys*, and are quite distinct from those of *Plesiosminthus*.

***Leidymys lockingtonianus* (Cope), 1881**

Figure 3, and Cope, 1885, Pl. LXIV, figs. 10-10e

*Eumys lockingtonianus* Cope, 1881a.

*Pacculus lockingtonianus* (Cope), Cope, 1881b.

HOLOTYPE.—A.M.N.H. No. 7028, a fairly complete skull.

HORIZON AND LOCALITY.—Upper Oligocene Middle John Day, The Cove, John Day River, Oregon.

DIAGNOSIS.—Tooth pattern similar to that of *L. nematodon*, as far as can be told; supraorbital crests much weaker; upper incisors compressed, with no grooves, but with two faint ridges toward the lateral side.

The teeth of this specimen are so badly worn that very few characters are visible. The buccal crest of the central cusp clearly reaches almost to the buccal margin of the tooth, as in *L. nematodon*, and the general configuration, particularly of the third molar, is quite different from that of *Eumys*. There is no trace of the antero-posterior compression of the paracone and metacone, which seems to be characteristic of *Pacculus*, nor is the buccal crest of the central cusp as long as in that genus. There is a faint crest near the center of the upper incisor, and a rather stronger one at the buccal side, features which have not been observed in any other North American Tertiary Cricetids.

The infraorbital foramen seems much larger and more Dipodid in appearance than in the Cricetids, which was doubtless one basis for Hay's reference of this form to the Zapodidae. A large part of this resemblance, however, is due to breakage of the foramen in the fossil, although there seem to have been some differences from the type of foramen found in *Eumys*. The anterior palatine foramina are very large, as are also the auditory meatus and the interparietal.

***Pacculus insolitus* Cope, 1879**

Figure 4, and Cope, 1885, Pl. LXVI, Figs. 31-32

GENOHOLOTYPE.—A.M.N.H. No. 7022, palate with  $M^{1-2}$  of both sides.

HORIZON AND LOCALITY.—Upper Oligocene Middle John Day Beds, The Cove, John Day River, Oregon.

DIAGNOSIS.— $M^{1-2}$  with five compressed transverse crests, all of subequal width and length; paracone and metacone little if any more prominent than central cusp; all five crests subparallel; protocone uniting with lingual margin of anterocone.

The tooth pattern of this form is close to that of *Leidymys* and *Eumys* in some respects, but differs rather fundamentally in the great antero-posterior compression of the paracone and metacone, a character not seen among contemporary Cricetids, but found among the Sicistids. It is this, in part, that has led Hay (1902) to assign this genus to the Zapodidae. There is, however, no trace of  $P^4$ , and the large anterocone of  $M^1$  indicates that there has been a considerable lapse of time since the premolar was lost. The teeth are shorter and narrower than in *Leidymys*, but the difference is probably too small to have much significance. The palate is short, as in *Leidymys*.

There is a considerable resemblance between *Paciculus* and some of the more primitive Sicistids, especially *Plesiosminthus myarion* from the Aquitanian (Schaub, 1930). The elongation of the central crest and the pentalophoid character of the tooth are Sicistid features. There is, however, sufficient distinction in the anterior end of the tooth row, and particularly in the entire absence of the upper pre molar, so that there is no question but that this form cannot belong to either the Sicistidae or the Zapodidae, and is certainly nearer to the Cricetidae than to any other group. Moreover, the valley between the paracone and the anterior cingulum of the second molar opens freely at its buccal end, instead of being closed as in *Plesiosminthus*. The reference of this form to the Cricetidae is strengthened by the occurrence of a very similar type among the European members of the family, *Heterocricetodon stehlin* (Schaub, 1925, Pl. rv, fig. 7) having a very similar type of pattern, though derived from a different source from that of *Paciculus*.

#### COPEMYS, NEW GENUS

GENOTYPE.—*Eumys loxodon* Cope, 1874a.

DIAGNOSIS.—Lower molars tending toward alternation of external and internal cusps; central cusp apparently absent; posterior arm of protoconoid of  $M_1$  extended as crest to lingual margin of tooth; protoconoid free from metaconoid; no hypoconulid on  $M_2$ , posterior cingulum arising from external border of hypoconoid.

#### *Copemys loxodon* (Cope), 1874

Figure 5, and Cope, 1877, Pl. LXIX, fig. 15

*Eumys loxodon*, Cope, 1874a.

*Hesperomys loxodon* (Cope), Cope, 1874b.

*Eumys loxodon* Cope, Cope, 1875.

*Eumys loxodon* Cope, Allen, 1877.

*Peromyscus lozodon* (Cope), Hay, 1902.

HOLOTYPE.—U.S.N.M. No. 1204, lower jaw with  $M_{1-2}$  right.

HORIZON AND LOCALITY.—Santa Fé Miocene or Pliocene Beds of New Mexico.

DIAGNOSIS.—The same as that given above for the genus.

This species has had rather a varied taxonomic history, as indicated above. It differs materially from *Hesperomys* and *Peromyscus* in having more brachydont teeth, the crowns being little if any higher than in *Eumys*. The alternation of the cusps, while at first suggestive of a tendency toward the *Peromyscus* pattern, is, however, actually leading in a rather different direction. The peculiar position of the posterior cingulum of  $M_2$  is like nothing with which I am familiar. It is possible that the long central crest is a growth from the central cusp, and it is also possible that it represents merely the posterior arm of the protoconid.

There can be no question but that this form represents a genus that is much more progressive than *Eumys*, and one that is fairly specialized in its own direction, though that direction does not appear to be toward any other late Tertiary or recent group of Cricetids, with the exception of certain species from the Miocene and Pliocene of California and Nevada, which have been described as *Peromyscus*.

## DENTAL MEASUREMENTS

(all measurements in millimeters)

TABLE I. UPPER TEETH

	<i>Leidymys nematodon</i> A.M.N.H. No. 7018	<i>Leidymys lockingtonianus</i> A.M.N.H. No. 7028	<i>Paciculus insolitus</i> A.M.N.H. No. 7022
$M^{1-3}$	6.41	6.78	5.65
$M^1$ , antero-posterior	2.61	2.77	2.32
width, anterior loph	0.89	1.11	1.82
width, protoloph	1.75	1.94	1.90
width, metaloph	1.79	1.98	1.90
$M^2$ , antero-posterior	2.02	2.09	1.94
width, protoloph	1.86	2.08	2.01
width, metaloph	1.83	1.94	1.89
$M^3$ , antero-posterior	1.83	1.84	..
width, protoloph	1.83	1.84	..
width, metaloph	1.50	1.48	..

TABLE II. LOWER TEETH

	<i>Eumys</i> <i>elegans</i> A.N.S.Phila. No. 11027	<i>Copemys</i> <i>lozodon</i> U.S.N.M. No. 1204
M <sub>1-3</sub> , alveolar length	7.00	..
M <sub>1</sub> , antero-posterior	..	1.70
width, metalophid	..	1.10
width, hypolophid	..	1.15
M <sub>2</sub> , antero-posterior	2.26	1.57
width, metalophid	1.96	1.22
width, hypolophid	1.95	1.27

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# AMERICAN MUSEUM NOVITATES

Number 823

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

March 9, 1936

59.9, 2 (95)

## RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 8

### FOUR APPARENTLY NEW POLYPROTODONT MARSUPIALS FROM NEW GUINEA

BY G. H. H. TATE AND RICHARD ARCHBOLD

Identification of the *Peramelidae* and *Dasyuridae* collected by the 1933 Archbold Expedition to New Guinea being now completed, it has been found necessary to draw up the following descriptions<sup>1</sup> of seemingly new forms.

Colors used in description in the following pages are those of Ridgway (1912, 'Color Standards and Nomenclature'); dimensions are given in millimeters and elevations in meters.

#### *Echymipera oriomo*, new species

TYPE.—No. 104573, Amer. Mus. Nat. Hist.; male, adult; Dogwa, Oriomo River, Western Division of Papua, 30 meters; March 1, 1934; collectors, Richard Archbold and A. L. Rand. The type is a skin and skull in fair condition (basioccipital broken away).

GENERAL CHARACTERS.—A small-sized, relatively warmly colored species with strongly spinous pelage and relatively small-sized teeth.

DESCRIPTION.—Pelage with the characteristic "agouti" ticking dorsally, composed of blackish spines whose terminal 2 to 4 mm. are colored about ochraceous tawny; sides and rump with less fuscous and more tawny; scattered straw-colored hairs protruding a few mm. beyond the spines of the back; top of rostrum and of head with short spines of mixed gray and straw color; a broad band from the base of vibrissae through eye to base of ear clothed with gray spines from which the straw color is absent; cheeks straw-colored tinged with ochraceous buff; ears fuscous; tail fuscous above, whitish beneath; hands, forearms, and feet near cartridge buff or ivory yellow; entire under parts ivory yellow; soles of hind feet fuscous-pigmented, of fore feet apparently without pigment.

SKULL.—Of characteristic *Echymipera* form, but smaller over all than the *doreyana* section and with posterior palatal openings extending from the front of  $m^1$  only as far back as the back of  $m^2$ ; zygoma rather slender and weak; teeth very small.

DENTITION.—Incisors much smaller than in *doreyana*;  $i^1-4$ , 4.7 (in *doreyana*, 5.3); canines and premolars proportionately small; length crown  $p^4$ , 2.9 (in *doreyana*, 3.3); molars, though virtually equal morphologically to those of *doreyana*, greatly inferior

<sup>1</sup> Descriptions of new mammals of other families have appeared in Amer. Mus. Novit., Nos. 801-804 and 810.

in size, outer margin of  $m^3$ , 3.6 (in *doreyana*, 3.9), transverse width,  $m^3$ , anteriorly, 3.3 (in *doreyana*, 3.6).

MEASUREMENTS (general).—Head and body, 244 mm.; tail, 67; hind feet (s.u.), 47; same (c.u.), 53; skull, basal length, 52.3; zygomatic width, 24.0, nasals,  $24.3 \times 2.4$ ; palatal length, 35.2; bulla, length, 4.3; teeth (crowns),  $c-m^4$ , 25.3;  $m^1$ - $i^3$ , 10.5.

This species is based upon two adult males and one young female (topotypes). In both paratypes the color is similar to that of the type. In the female,  $p^4$  and  $m^4$  are as yet only partly erupted.

A number of forms of *Echymipera* have been described, but so inadequately that proper comparisons could not be made on the basis of literature only. The large-toothed *doreyana*-like species are certainly distinct from *oriomo* and whether such forms as *cockerelli* and *rufescens* (= *keiensis*) are nearly related can be settled only after detailed examination of the types has been made and measurements of their teeth have been taken.

#### *Phascogale rona*, new species

TYPE.—No. 104005, Amer. Mus. Nat. Hist.; female, adult; Rona, Laloki River, Central Division of Papua; March 14, 1933; collectors, Richard Archbold and A. L. Rand. Type a skin and skull in fair condition (skull with occipital region broken).

GENERAL CHARACTERS.—A very small species of *Phascogale* with small feet, wide, short skull, rostrum and palate, and rather large bullae.

DESCRIPTION.—Dorsal pelage 9–10 mm., fuscous gray at base, tipped with pale whitish gray, which on the rump, sides, and thighs becomes faintly washed with cinnamon; crown darker than back, also washed with cinnamon which latter color approaches ochraceous tawny on frons and rostrum; cheeks and below ears pure ochraceous tawny; feet and hands pale whitish gray; under parts light sandy gray with darker gray bases; chin and throat light ochraceous buff; hair in pouch russet; tail brownish fuscous above, buffy beneath; ears, rather large, light fuscous. The collector reports on label "3 pairs of mammae in pouch."

SKULL.—Though very small, short and massive, zygomata well broadened, and rather heavy; nasals scarcely broader behind than in front, their anterior parts formed somewhat as described by Jentink<sup>1</sup> for *naso*; postorbital processes small but distinct eminences; palate short and broad, with teeth rather crowded; a postnasal spine; anterior palatal foramen reaching almost to back of canine; bullae rather large, their diameters equal to about three quarters of their distance apart.

DENTITION.—A diastema between  $i^1$  and  $i^2$ ;  $i^4$  larger than  $i^3$  or  $i^2$ ;  $c$  long, little curved;  $p^1$ ,  $p^2$ ,  $p^4$  crowded, becoming successively larger;  $m^1$ - $m^3$  becoming successively shorter anteroposteriorly (measured along outer face) and wider;  $m^4$  normal for genus.

MEASUREMENTS.—Head and body, 128 mm.; tail, 98; hind foot (s.u.), 21; skull, basal length, 25.3; zygomatic breadth, 16.3; mastoid breadth, 11.6; nasals,  $9.7 \times 3.3$  (combined); palatal length, 13.7; anterior palatal foramen, 2.6; length bulla, 2.9; crowns  $m^1$ - $i^3$ , 5.1; crown dimensions of  $m^1$ ,  $1.8 \times 1.5$ ; of  $m^2$ ,  $1.8 \times 1.8$ ; of  $m^3$ ,  $1.6 \times 2.1$ .

<sup>1</sup> Jentink, 1911, Notes Leyden Museum, XXXIII, pp. 236–237.

*P. rona* is based upon the type specimen only. The arrangement of its incisors and premolars suggests that it belongs in the subgenus *Antechinus*. It is, however, widely different from another *Antechinus* of New Guinea, namely *P. melanura*. Perhaps it comes closest to *P. naso* from the Hellwig Mts., Dutch New Guinea.

***Phascogale tafa*, new species**

TYPE.—No. 104050, Amer. Mus. Nat. Hist.; female, adult; eastern slope of Mt. Tafa, Central Division of Papua, 2100 meters; May 25, 1933; collectors, Richard Archbold and A. L. Rand. The type is a skin and skull in good condition.

GENERAL CHARACTERS.—A mouse-like phascogale with long, bare-appearing mureoid tail and large, leafy ears; skull with rather narrow muzzle, and bullae not especially enlarged; most closely related to *longicaudata*.

DESCRIPTION.—Pelage dense but rather short for a highland species, only 6–7 mm. on back; color a dull brownish gray due to sepia-colored hair tips lying over a dark fuscous under color; under parts dull grayish buff, with a faint cast of yellowish, except the inguinal area where the mammae (shown by collector in notes to be 2–2) are surrounded by hairs colored tawny or russet; feet and hands only slightly paler than back; ears light fuscous, semi-translucent, apparently capable of being folded or coiled as in *Marmosa simonsi*; tail light fuscous above, scarcely paler beneath.

SKULL.—Rather long, with zygomata moderately and uniformly arched; post-orbital prominences not developed; nasals narrow, little widened posteriorly; rostrum somewhat elongate, blunt at the end; palate rather narrow; bullae moderate, their width slightly exceeding half of their distance apart.

DENTITION.—A slight diastema from  $i^1$  to  $i^2$ ;  $i^2$  higher than  $i^3$  or  $i^4$ , but  $i^4$  with longer crown than  $i^2$  or  $i^3$ ; c straight, sharp;  $p^1$ ,  $p^2$ ,  $p^4$  graded from small to large, but a slight space between  $p^1$  and  $p^3$ ; outer faces of  $m^1$ – $3$  subequal in length, their widths, however, increasing successively.

MEASUREMENTS.—Head and body, 134 mm.; tail, 145; hind foot (s.u.), 25.0; basal length, 29.7; zygomatic breadth, 17.3; interorbital breadth, 7.7; mastoid breadth, 13.1; nasals,  $11.1 \times 3.5$  (combined); palatal length, 17.1 (no postnasal spine); length bullae, 3.1; crowns  $m^1$ – $3$ , 6.4; crown length permanent  $p^4$ , 1.5; crown dimensions of  $m^1$ ,  $2.3 \times 1.8$ ; of  $m^2$ ,  $2.3 \times 2.2$ ; of  $m^3$ ,  $2.2 \times 2.4$ ; width of crown of  $m^4$ , 2.4.

The nearest relative of this little animal is apparently *longicaudata* of the Aru Islands, described in 1866 by Schlegel and Müller.<sup>1</sup> That animal was also a female. No further discoveries of related specimens<sup>2</sup> were made until Thomas<sup>3</sup> reported a phascogale (also female) which he referred to *longicaudata*, from Haveri, behind the Astrolabe range, 700 meters. Whether that specimen is referable to *longicaudata*, or to *tafa*, or constitutes yet a third race in its own right is yet to be determined.

<sup>1</sup> Schlegel and Müller, 1866, Ned Tijdschr. Dierk., p. 356.

<sup>2</sup> The *murex* group is not necessarily closely allied to *longicaudata*.

<sup>3</sup> Thomas, 1897, Ann. Mus. Civ., Genova, (2) XVIII, p. 621.

**Phascogale (Phascolosorex) dorsalis whartoni**, new subspecies

TYPE.—No. 104046, Amer. Mus. Nat. Hist.; male, adult; eastern slope of Mt. Tafa, Central Division of Papua, 2070 meters; May 23, 1932; collectors, Richard Archbold and A. L. Rand. The type is a skin and skull in fair condition (right malar bone missing).

GENERAL CHARACTERS.—A single-striped phascogale of the subgenus *Phascolosorex* (diastema between  $i^1$  and  $i^2$ ;  $p^4$  larger than  $p^3$ ; rostrum slender), and most nearly like *P. dorsalis*, though of even smaller size.

DESCRIPTION.—Pelage dorsally, 8–9 mm. in length; dorsal color bone brown with light flecks of russet or tawny, overlaid scantily by longer black guard hairs. Median dorsal line entirely black, widest (8 mm.) on neck, extending from rostrum to rump and even onto base of tail; under parts from sayal brown to tawny, the hairs with concealed gray bases; transition to dorsal pelage gradual; ears short, middle of conch incised and folded, with short clothing of dark brown hairs; hands and feet with their fuscous hairs tipped with dull tawny; tail fuscous above and below, moderately haired (hairs though appressed reaching 5 mm.); tip of tail in type not white (white in paratypes). Claws of forefeet slightly larger than those of hind feet.

SKULL.—As indicated under "general characters." Frons raised, base of rostrum depressed; back of nasals moderately expanded; palate moderately long, compressed at level of  $p^1$ ; bullae moderate in size, diameter slightly less than two-thirds their distance apart.

DENTITION.—As in *doriae* but very much smaller (no specimens of *dorsalis* have been available for examination).

MEASUREMENTS.—Head and body, 173 mm.; tail, 131; hind foot (s.u.), 25; skull, basal length, 36.7; zygomatic breadth, 21.0; nasals,  $15.2 \times 5.7$  (combined); palatal length, 20.9; anterior palatal foramen, 4.3; length bullae, 3.5; crowns  $m^{1-3}$ , 7.3; crown length permanent  $p^4$ , 1.1; crown dimensions of  $m^1$ ,  $2.5 \times 1.6$ ; of  $m^2$ ,  $2.4 \times 2.0$ ; of  $m^3$ ,  $2.3 \times 2.3$ ; width of  $m^4$ , 2.4.

Besides the type there are in our collections two young adult females from Mt. Tafa (both with the tip of tail broken), and from Murray Pass, Wharton Range, an adult male with the terminal 18 mm. of the tail yellowish white.

It seems probable that when true *dorsalis* is rediscovered it will be found to occur at greater altitudes than the larger *doriae* (common in collections) does.

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STRUCTURE OF A PRIMITIVE NOTOUNGULATE  
CRANIUM<sup>1</sup>

BY GEORGE GAYLORD SIMPSON

Constituting, as they did, the most abundant and varied element in the vertebrate fauna of a large continent throughout the long duration of the Tertiary, the notoungulates are of exceptional interest and importance. Adding to, rather than detracting from, this interest are their origin, the peculiarity of their structure, and the difficulty of interpreting their history. Study of the later forms, particularly those of the Santa Cruz and of the relatively impoverished Pampean, has revealed most of the surface morphology of a number of divergent lines. In the endeavor to interpret these data and to approach solutions to the many problems which arise from them, we are now turning to the oldest known forms, and especially those of the Casamayor Formation (so-called "*Notostylops* Beds"), of Eocene age.

This study of the older notoungulates embraces two points of view and bears on the study of the notoungulates in two ways. First, the early forms may be considered as the culmination of still more ancient development. They may be compared with an abstraction or hypothesis as to the generalized ancestral ungulate, subungulate, or protoungulate, and they may be compared with actual groups which developed elsewhere in the world, such as the condylarths or the hyracoids. These Casamayor notoungulates stand somewhere near a possible phyletic union with these other groups, and their study is the best approach now available for the study of the genetic origin of notoungulates and of the morphologic origin of their peculiarities. Second, these early forms may be considered as the root or base of later notoungulate development. Within the Notoungulata they can or may clarify structural problems, by showing the form in which the structural peculiarities first appeared. They should also greatly illuminate phylogenetic obscurities, not only by giving criteria for distinguishing basic ordinal characters from those progressive in or peculiar to the various phyla but also by showing these phyla at a period when they were so little divergent that

<sup>1</sup> Publications of the Scarritt Expeditions, No. 26.

their affinities had not yet been masked, at least to such a degree, by specialization peculiar to each line.

Peculiar interest and difficulty in this connection attach to the cranial characters. Even in the later forms some of these are not well understood and there are many points that have been, and still are, the subject of radical differences of opinion. Materials for the study of the Casamayor genera have been very inadequate, and until quite recently no detailed studies of their cranial morphology have been undertaken.

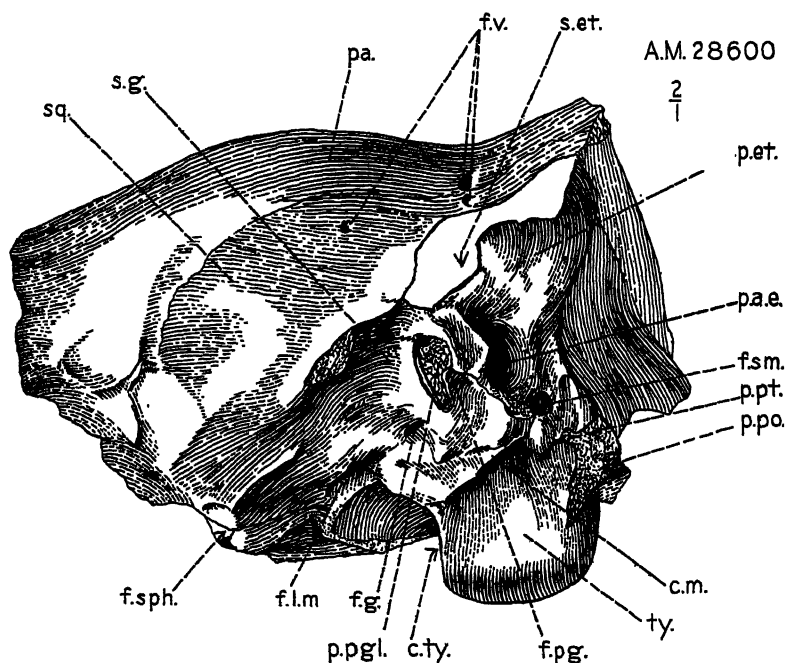


Fig. 1. *Oldfieldthomasia*. Lateral view of left half of cranium. For abbreviations see p. 29. Twice natural size.

The purpose of this paper is to describe the cranial morphology of a Casamayor notoungulate that is a rather generalized representative of its order. One specimen, incomplete in some respects and unclear in others, cannot give complete knowledge of its genus, and knowledge of one genus, primitive but certainly not generalized in every respect, cannot be completely representative of primitive notoungulate structure. Nevertheless, a useful approach toward that ideal is possible.

The specimen studied is Amer. Mus. No. 28600, an isolated but nearly complete cranial portion of a skull found by Justino Hernández in the Casamayor Formation of "Cerro Blanco,"<sup>1</sup> southern Chubut, Argentina. As no teeth were found with the specimen, absolutely certain identification is impossible. The genus is, however, almost surely *Oldfieldthomasia*, on this evidence: it closely resembles the skull of *Oldfieldthomasia*<sup>2</sup> *debilitata* in the Museo Nacional in Buenos Aires; it does not so nearly resemble known skulls of other genera; its size is appropriate for the most characteristic and common species of *Oldfieldthomasia* and less definitely within the probable range of other genera; *Oldfieldthomasia* is one of the commonest genera of this horizon; and other common genera such as *Notostylops* or *Notopithecus*, are definitely ruled out by differences in their known cranial morphology. Specific identification is impossible, but it might be of the common species *O. debilitata* or *O. furcata* (possible synonyms).

The cranium is preserved with practically no crushing, an extraordinary rarity in this formation, and the internal matrix is hard and firm, almost ideal conditions for sectioning. The condyles are missing and most of the projecting processes and crests are broken or somewhat eroded, but the more essential internal structure is well preserved. The specimen is adult or senile, with most of the sutures indistinguishable on the surface, but they are seen with much better, although not perfect, clarity in sections.

The most important part of this study is based on serial sections which were made by a simplified method described elsewhere (Amer. Mus. Novitates No. 634). Some points are left obscure, but on the whole the results are satisfactory and provide a wealth of accurate detail seldom previously equaled in the study of any fossil mammal.

The cranium was first sawed vertically along the midline. The left half was preserved for surface morphology and orientation, and the right half was embedded in plaster (hardened with gum and shellac) and sectioned serially. A series of parasagittal sections at intervals of 0.4 mm. were taken. Sectioning was begun at the most lateral point, and recording started when sufficient bone of the ear region was exposed to be in an area of distinctive preserved morphology. The sections from this point are numbered serially from 1 to 54, covering a thickness of 21.2 mm. Section 1 is 24.6 mm. from the midline of the skull, and sec-

<sup>1</sup> A local descriptive name, not official or distinctive. In this sparsely populated and poorly surveyed region, no very exact way of designating localities yet exists. Our Cerro Blanco is on the south rim of the Cuenca de Sarmiento, southwest of Lago Colhué-Huapi, and west of the famous barranca south of that lake. A map is in preparation.

<sup>2</sup> Placed in *Acoelodus* by Ameghino.



tion 54 is 3.4 mm. from the midline. Subsequent cuts revealed nothing of interest, being beyond the ear region and all foramina and in the uniform and simple basicranial axis.

The principal record is in the form of a careful camera lucida drawing, twice natural size, of each section. The drawing was carefully checked by me in each case, and the actual section also studied closely before proceeding to the next cut. This recording and the drawings here published are by Mrs. Mildred Clemans. Coleman S. Williams prepared the specimen for sectioning and rendered other assistance.

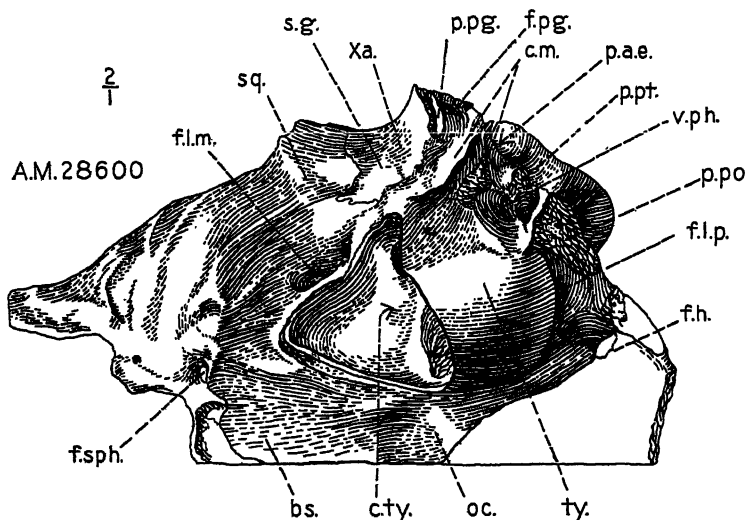


Fig. 2. *Oldfieldthomasia*. Ventral view of left half of cranium. For abbreviations see p. 29. Twice natural size.

In the study of the sections, use was also made of transparencies, both on paper and on glass, that could be superposed to show the natural relationships, and also of projections in various planes reconstructed from the sections. The external morphology of the unsectioned half was studied in the ordinary way, and also by soaking the specimen in xylol until the bone became almost transparent.<sup>1</sup> Many other specimens of notoungulates were also studied, but are not specifically described in the present paper. One of *Pleurostylodon* is, however, figured to assist

<sup>1</sup> This useful general procedure of immersion in studying fossils has previously been used to good effect by Stensio, Noble, and others. Xylol proved particularly suitable in the present case, and has the advantage that the bone returns to its original condition when thoroughly dried.

in visualizing part of the structure of the closely similar *Oldfieldthomasia* skull.

No previous work of just this sort or in quite such detail seems to have been done on fossil mammals, but the work by Patterson on external cranial characters of notoungulates and that of Van Kampen and Van der Klaauw on the tympanic region of mammals in general (see reference at end of paper) have been particularly useful.

#### BONE ELEMENTS

This section is concerned with the number of individual bones present and their identity, not primarily with their topography, which is described below or adequately shown in the figures.

The only elements in the cranial roof (anterior to the supraoccipital) are the squamosal and the parietal, which are here readily distinguishable in the sections and in the unsectioned half of the skull.

The sutures in the anteroinferior region are more confusing, the sutural lines being very complex and often nearly in the plane of the sections, which greatly obscures them, but after close study, with transparencies, it appears that there are here, anterior to and above the bulla, four different elements. One is continuous with the basisphenoid medially, extends laterally below the sphenorbital fissure, forms a strip along the anterolateral edge of the bulla including the anterior rim of the foramen lacerum medium, and finally disappears in the somewhat confused region anterior to the lateral corner of the bulla. This clearly must be the alisphenoid.

A second element forms the upper rim of the sphenorbital fissure and the vertical cranial wall anterior to this and extends laterally for a short distance, about to section 40. This I take to be the orbitosphenoid. A still more anterior element, poorly developed in the sections because the anterior break barely includes its posterior end, appears anterior to and above the orbitosphenoid with a clear suture against the latter (section 45) and against the parietal (section 40) and disappears at about the same point laterally (about section 38). This is probably the posterolateral edge of the frontal.

Overlapping and, at its extreme medial end, partly inserted into the alisphenoid, first appearing definitely in about section 39 (in going through the sections from the midline outward), is another element which becomes larger laterally until it excludes the alisphenoid from contact with the parietal and in the area anterior to the glenoid surface forms the whole inferolateral wall of the cerebral cavity. With the

lateral disappearance of the parietal, the element in question is seen to be continuous with the dorsal part of the squamosal and is, of course, part of that bone.

The individuality of the petiotic and its extent are not in any doubt. There are only two sections (26 and 27) in which there is any possible question as to its outline, and here only because it rapidly expands posteriorly, with the lateral boundary of this extension nearly in the plane of the section so that it is not clearly shown.

The occipital elements are completely fused with each other without

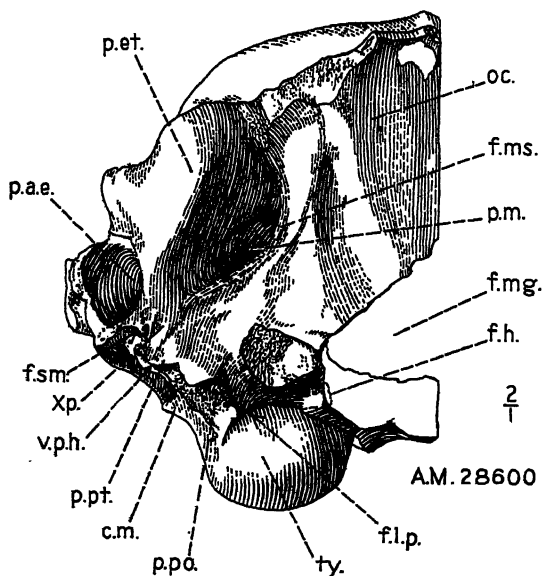


Fig. 3. *Oldfieldthomasia*. Posterior view of left half of cranium. For abbreviations see p. 29. Twice natural size.

any trace of division, so that they are simply labeled "occipital" in the sections and other figures. The only place in which this compound occipital is not clearly separated from the adjacent bones is in the median ventral axis, where the basioccipital is completely fused with the basisphenoid, although the presence of a slight ridge and the relationships to the endocranium show where this division occurred.

It is regarding the elements of the ear region that there has been the greatest question. These are very poorly understood, and unfortunately the present specimen is not sufficiently well preserved nor are its sutures

sufficiently clear at every point for a complete solution of this intricate problem. It does, however, provide many data, some of which are of particular interest and value. In order to discuss the problem, a brief historical review is necessary.

The Order Notoungulata was first defined by Roth (1903) on the structure of the ear region, which he considered unique among ungulates. An essential point was his belief that the parts usually formed by the squamosal are in notoungulates formed by a number of different elements. In the general posterolateral region he recognized the following bones as distinct:

1. *Squamosum* [the squamous part of the squamosal].
2. *Elementum zygoma* [the zygomatic process of the squamosal, said to be suturally separated in some cases].
3. *Elementum seriale*, with the *pars mastoidea* [around and above the auditory notch and containing the epitympanic sinus].
4. *Petrosum* [containing the inner ear, and also exposed on the occiput].
5. *Tympanicum* [which he said to be continuous with the *posttympanicum*].<sup>1</sup>

Roth homologized these with various reptilian elements in a way thoroughly discredited by later research and requiring no further discussion.

Scott (1912, p. 290), in discussing toxodonts, rejected Roth's identification of element 3 as the mastoid, and pointed out that the epitympanic sinus lies in part of the squamosal, said on Roth's authority to be sometimes suturally separate from the squamous part. This he calls the *pars serialis*, thus giving the term a slightly different concept from that of Roth, since the latter labels with this name the supposed lateral extension, and also inferolateral into the postglenoid process, of his supposed mastoid, a possibility not discussed by Scott. Scott identified the plate between postglenoid and posttympanic processes (in *Nesodon*) as the mastoid (true mastoid, not of Roth).

Sinclair (1909, p. 71), describing the Santa Cruz typotheres, speaks of the epitympanic sinus as being in the mastoid, and figures an occiput of *Hegetotherium* in which, in addition to the occipital elements, there are suturally separate "mastoid" and "posttympanic" exposures, the names being applied as they were by Roth in this region.

Patterson (1932) differs from Scott and agrees with Roth in considering the plate between postglenoid and posttympanic processes as part of

<sup>1</sup> Roth's paper is very difficult to follow, as the terminology is not consistent throughout, some lapses evidently occur, and the subject is inherently very complex. In spite of earnest effort, I am not certain that I have correctly grasped every detail of his apparently somewhat contradictory opinions. Patterson (1932, p. 19) evidently gathered that Roth considered the posttympanic as a separate bone, while I understand Roth to mean that it is part of the tympanic. There is also some question as to whether Roth invariably considered his "serialis" and "mastoid" as the same bone, but apparently he did.

the tympanic. He agrees with Scott and differs from Roth and Sinclair in considering the epitympanic sinus to be in a "pars serialis" of the squamosal. The occipital element which Roth called posttympanic and (if I rightly understand him) believed to be part of the tympanic, is stated by Patterson to be a separate entity in some but not all notoungulates. He suggests, without approving, homology with the tabular.<sup>1</sup> He homologizes Roth's "protuberantia petrosa" with the true mastoid.<sup>2</sup> Patterson later (1934) suggested that the "posttympanic" or "adventitious bone" might be part of the mastoid, but considered this as improbable.

Regarding certain of these questions the present study gives answers which, anticipating the evidence, are as follows:

1. The epitympanic sinus is not in the mastoid but in part of the squamosal.
2. The "posttemporal" or "adventitious bone" is not part of the mastoid, nor of the tympanic.
3. The plate between postglenoid and posttympanic processes is part of the tympanic.
4. The region around and above the meatus, including most of the part labeled "serialis" by Roth, is not, as he thought, continuous with the epitympanic sinus wall (at least in this specimen).
5. Roth's "protuberantia petrosa" is the true mastoid, in as far as that element can be said to occur at all.

These conclusions refer primarily to the specimen principally studied in this paper, but from comparison with many other specimens and with the literature it seems probable that they are also valid generalizations for the Notoungulata as a whole. They are in essential agreement with Patterson's views, based on external characters of early members of all suborders. This much of the notoungulate structure now seems to be beyond probable doubt.

Turning to the details of the present specimen, the occipital sutures are very obscure, as usual, but can be almost certainly and fully determined in the sections. By a method of projection from the latter, a reconstructed posterior view of the essential portion of the occiput can be made (Fig. 4). Five suturally separate bones appear in this view:

1. The occipital (its elements completely fused).
2. The squamosal, enclosing the epitympanic sinus.

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<sup>1</sup> No final conclusion is possible and it would be futile to discuss the matter in detail at present, but I have gone rather thoroughly into the supposed occurrence of tabulars in mammals and believe it highly unlikely that this notoungulate element, at least, can be so homologized.

<sup>2</sup> spec.  
Patterson's figures (e. g., 3, 4a) really is, or includes, Roth's posttemporal, Patterson's adventitious bone. It is perhaps this confusion, if it exists, that led him later to suggest that the "adventitious bone" may in fact be part of the mastoid.

3. The tympanic (forming the bulla and part of the meatus, not extending onto the occiput proper).
4. The periotic, or its pars mastoidea.
5. The "adventitious bone," marked Xp.

The wall of the epitympanic sinus, although somewhat broken (especially in the lateral part), appears to be a single bone and is surely separate from any of the elements below it. There are some cracks above which may suggest, in single sections, that a suture against the squamous part of the squamosal is present, but in no case is this clearly a suture and studying the whole series of sections it seems very improbable that a suture is present at all, in this specimen. The epitympanic sinus appears to be an inflation of the squamosal, proper, well distinguished topographically but not a distinct osseous element. Roth based his belief that the epitympanic walls, and in some cases subjacent parts as well,

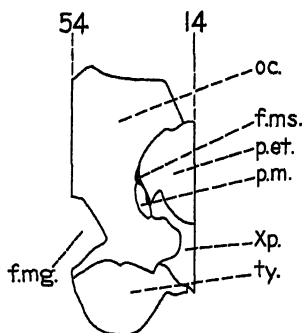


Fig. 4. *Oldfieldthomasia*. Diagram of part of right half of occiput, from sections 14 to 54, reconstructed from serial sections. For abbreviations see p. 29. Natural size.

form a separate element in notoungulates on the very rare supposed presence of a suture against the squamosal. Apparently he only believed himself actually to have observed this suture in two cases, and these are open to question, since there is a strong possibility that the supposed suture is merely a crack. As far as I know, no subsequent student has recorded a suture in this region, all (see especially Sinclair, Scott, Patterson) indicating the epitympanic wall (whatever they call it) as fused with the (rest of the) squamosal. Without denying the possibility of sutural separation, it is fair to say that none is demonstrated and the epitympanic wall may at least provisionally be considered as a part of the squamosal, for which I propose the name *pars epitympanica*.<sup>1</sup>

<sup>1</sup> This non-committal, correctly descriptive term seems very much preferable to the only really available previous designation, *pars serialis*. The latter term is of rather anomalous etymology and not well in keeping with modern anatomical terminology, being a neo-Latin adjective formed from the proper name Serres. It implies, or demands, a homology which is very dubious, that is, with the posteroinferior center of ossification in the squamosal in man. Finally, its application to the notoungulate skull has not been perfectly clear or consistent.

The true mastoid, which is very clearly shown by the sections to have nothing to do either with the *pars epitympanica* of the squamosal, or the *crista meati* of the tympanic, or the "adventitious bone," must be represented by the posterior projection of the periotic which in this genus and many (but not all) other notoungulates has a small occipital exposure.

It is the "adventitious bone," Xp, that remains extremely dubious, not as to its individuality, which is demonstrated, but as to its identity. Although it shows some apparent tendency to fuse with the tympanic in this skull, and in others studied seems to be completely so fused (being, for instance, considered part of the tympanic by Roth, as I interpret his paper, although he certainly overlooked no possible sutures in his material), there is in several sections (e. g., 17) a clear suture which cannot possibly be a crack. Even though the suture is apparently lost by fusion in other regions, its certain presence in any part is sufficient demonstration of the separate individuality of the bones in question. Its separation from the (ex-) occipital is still more certain, as the latter simply overlies it without forming a sutural connection (e. g., section 20). Separation from the *pars epitympanica* is not clear in all sections, probably because of the imperfection of the specimen, but is in some (e. g., section 20), and this suture clearly developed on the occiput has been distinguished externally in a number of different genera.

The only apparent true connection of this bone is seen in sections 20-22, where it passes without a visible break into a bridge of bone above the medial end of the external auditory meatus, immediately lateral to the epitympanic recess, and is in this way united with an element developed in the postglenoid process, anterior to the tympanic. This does not necessarily prove that these are the same bone, as fusion of really separate elements in the few crucial sections could well occur, but it demands new evidence to demonstrate separability.

A remarkably anomaly, and one apparently not hitherto recorded, is the presence of another "adventitious bone," or of an anterior process of the same one, in the postglenoid process, labeled Xa in the figures. The separability of this from the tympanic is clear, a distinct suture being present throughout (e. g., section 15, 20). It is equally distinct from the *pars epitympanica* and the periotic, both of which are in contact with it but without even a sutural union. In its more medial part, separation from the inferolateral part of the squamosal is not clearly shown, because of cracks in this region and, doubtfully, partial fusion, but laterally it has a distinct suture against the *pars glenoidea* of the squamosal (e. g., section 10). In the sections this is unmistakably a true suture,

and it is, furthermore, clearly visible on the other, unsectioned, half of the skull running transversely across the glenoid surface to the squamoso-tympanic suture anterior to the *fissura glaseri*, exactly corresponding with its course as shown in the sections.

On present data it seems impossible to offer a reasonable explanation of these two adventitious bones, or two parts of one as the case may prove to be. The relationships are not perfectly clear in any described specimen, and the observation of the anterior element, or part, depends solely on this one specimen. Speculation on these grounds seems unwarranted, and the observations are merely recorded to form, it is hoped, a basis for the accumulation of essential further data.<sup>1</sup>

In the more lateral sections (especially 7-12) there is a bone in the base of the epitympanic sinus, above and lateral to the *porus acusticus*, which is consistently separate in the sections. This region is, however, badly cracked and it seems probable that the bone in question is not really a separate element. At least it should not be accepted as such without further evidence.

Lying loose and out of position in the medial part of the tympanic cavity (sections 50-53) is an auditory ossicle, probably the malleus, but the section interval is too great for useful reconstruction of its form. In sections 34-36 is another small bone in the bottom of the bulla, which may be another auditory ossicle or may be only a fragment of the broken wall of the bulla.

No other bone elements are present in the preserved part of the cranium.

#### EXTERNAL AUDITORY MEATUS

The roughly circular *porus acusticus* of this form has its upper rim nearly on a level with the glenoid surface, and from it the meatus runs forward, inward, and downward, although less oblique than in many later notoungulates. The meatus (from the point where it is completely encircled by bone) runs through eleven sections (13-23, about 4 mm.). Nearly circular at first, it becomes distinctly triangular (sections 19 seq.), with one of the three approximately equal angles downward, into the tympanic. The floor of the meatus is formed throughout

<sup>1</sup> Not to prejudice more definitive work, I apply no name to either part. The posterior part is the posttympanic of Roth and some others following him, but Scott apparently uses the term in a somewhat different sense. The name may become fixed in this usage if the element is a unit, since it does often or always form the true posttympanic process and is descriptively posttympanic in position, but it would seem to be inappropriate and confusing if this is part of the same bone that forms



by a thick, somewhat spongy plate of the tympanic, which also seems to form at least half of the posterior wall, and in some sections apparently most of this wall. The rest of the posterior wall, the roof, and the anterior wall are formed by the "adventitious elements," as discussed elsewhere.

The serial sections prove beyond any question that the ventral closure of the meatus is by a thickened extension of the tympanic, which everywhere separates the postglenoid and posttemporal processes. This strongly corroborates Patterson's view (1932, p. 18) that in toxodonts this plate is also part of the tympanic, not mastoid as Scott supposed. Conditions in this respect seem to be rather uniform throughout the Notoungulata, and all the specimens known to me permit the generalization that there is in this order always a tympanic plate between postglenoid and posttympanic process, the occurrence of a meatus spurium reported by Sinclair 1909 for *Protypotherium*, Scott 1912 for *Homalodotherium*, and Van Kampen 1905 for *Typotherium* is in no case substantiated and probably the report is due to failure to recognize the separate origin of a fused tympanic extension.<sup>1</sup>

The crista meati (Patterson 1934) is strongly developed on the present specimen and was apparently very prominent, although somewhat broken and hence not well shown in the sections. The crest is double, because of the development in it of a deep, very sharply defined longitudinal groove.<sup>2</sup> The posterior crest, or posterior rim of groove on the crista, abuts simply against the bulla posterior to the vagina processus hyoidei. The anterior crest swings forward on the external part of the bulla and ends internal to the glenoid fossa. Between the end of this and the postglenoid process, immediately posterior to the fissura glaseri, there is an isolated papilla of bone on the tympanic.

Upon arriving at the tympanic cavity, the internal lower rim of the meatus flairs out, becoming a semicircle of greater diameter than the meatus proper, and projects into the cavity as a pronounced crista tympanica,<sup>3</sup> which is open above (see section 25).

#### TYMPANIC CAVITY AND EPITYMPANIC SINUS

As in all notoungulates, the bulla is completely ossified, inflated, and (except, of course, for part of its dorsal wall) entirely formed by the

<sup>1</sup> The reported instances have all been denied by other workers. Scott seems to contradict Sinclair's statement, and Patterson's studies negative those of Scott and of Van Kampen.

<sup>2</sup> Possibly a canal, as a possible junction below may be broken away, but this seems improbable. Another skull of *Oldfieldthomomys* has an even larger groove, also open as preserved. Both crests are certainly on the tympanic.

<sup>3</sup> Note that the "tympanic crest" of Patterson's first paper (1932) is not the "crista tympanica" of other anatomists, and that he later (1934) renamed it the "crista meati."

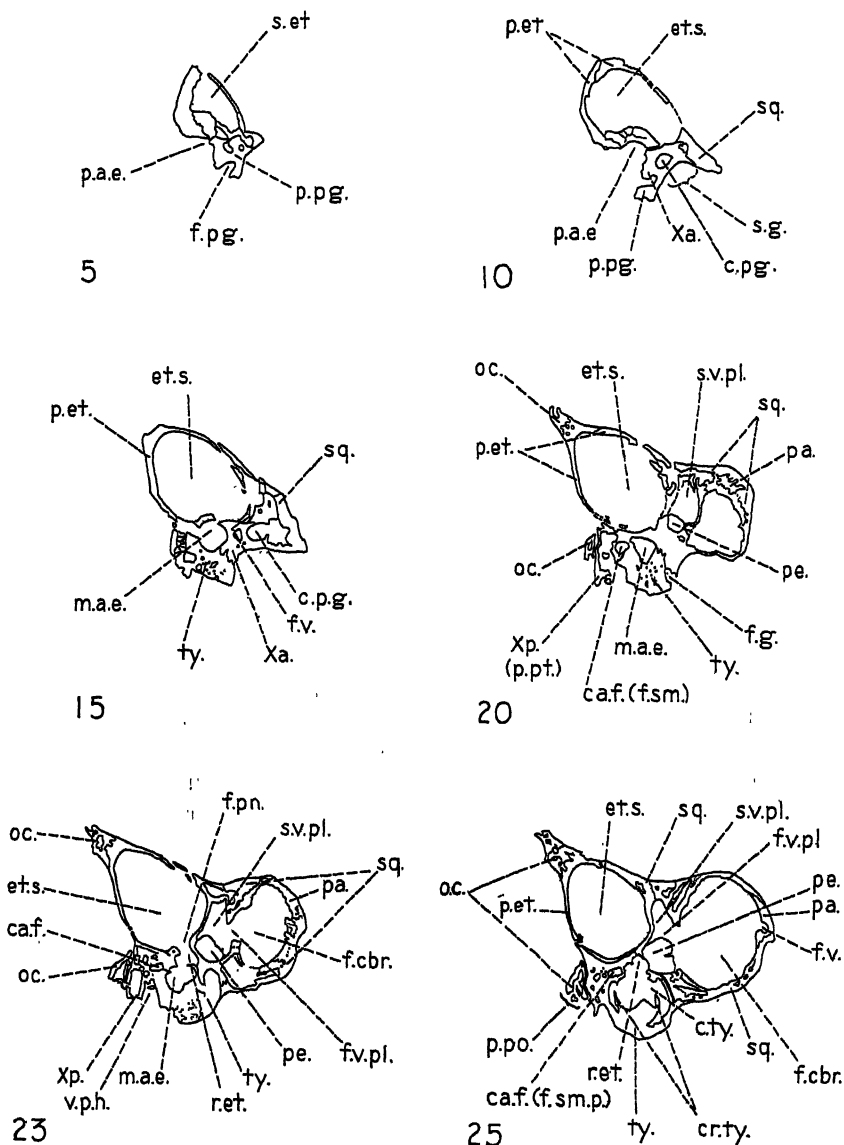


Fig. 5. *Oldfieldthomasia*. Parasagittal sections of cranium. The numbers correspond to those of the complete series of sections, see text. The right side is anterior. For abbreviations see p. 29. Natural size.

tympanic,<sup>1</sup> which is without any distinct trace of sutures. The recessus epitympanicus and, still more, the sinus epitympanicus are very distinct, although opening into the tympanic cavity, but the primary tympanic cavity and the hypotympanic sinus are completely hollow and poorly or not differentiated from each other. The complications in the walls of this large cavity are very few, the internal wall being for the most part a simple curved surface parallel to the visible outer surface.

There is a semicircular lateral extension of the cavity around the crista tympanica (sections 24-26). Immediately medial to this point there is a large but shallow pocket in the lateral wall at the posteroinfero-lateral point of the bulla (section 28) and immediately dorsal to this is a small projection, which disappears between two sections (present in 28, completely absent in 29). In section 29 a small pocket in the anterior wall of the bulla appears, and posterior to this, projecting into the tympanic cavity, are two low but definite projections. In the next section, 30, the small pocket merges into the general lumen of the bulla, and the ridge is single but with a hooked end and is considerably more prominent. Hence, in sections 31 to 33, the ridge becomes lower but stouter and more dorsal, until it reaches and passes into the dorsoanterior edge of the bulla wall. After this point the wall of the cavity is smooth and evenly curved.

Patterson has noted the presence of a septum bullae in typotheres (mentioned in Patterson 1934, but details not yet published), and it is well known that the hypotympanic sinus may be cancellous in various notoungulates. In the present skull it is not cancellous, and it seems unlikely that any real homologue of a septum bullae is present, although it is perhaps conceivable that the ridge just described is a vestige of that structure.

The tympanic gap ("tympanicumdefekt") extends to the extreme lateral edge of the cavity and indeed of the meatus, the tympanic itself not forming a closed ring until section 43. In the meatus and in small part at the beginning of the tympanic cavity the gap is apparently filled by the "adventitious elements," discussed elsewhere. In section 25 the periotic also appears in the roof of the gap which by section 28 it entirely occupies. The gap is here at its maximum. In section 33 it begins to be noticeably smaller and in 43 the edges of the tympanic meet beneath the periotic and the gap is closed, although the periotic continues to overlie the thin superior wall of the cavity nearly as far as the latter extends.

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<sup>1</sup> I shall use "tympanic" for the entire element, without regard to a possible combination of ectotympanic and entotympanic elements.

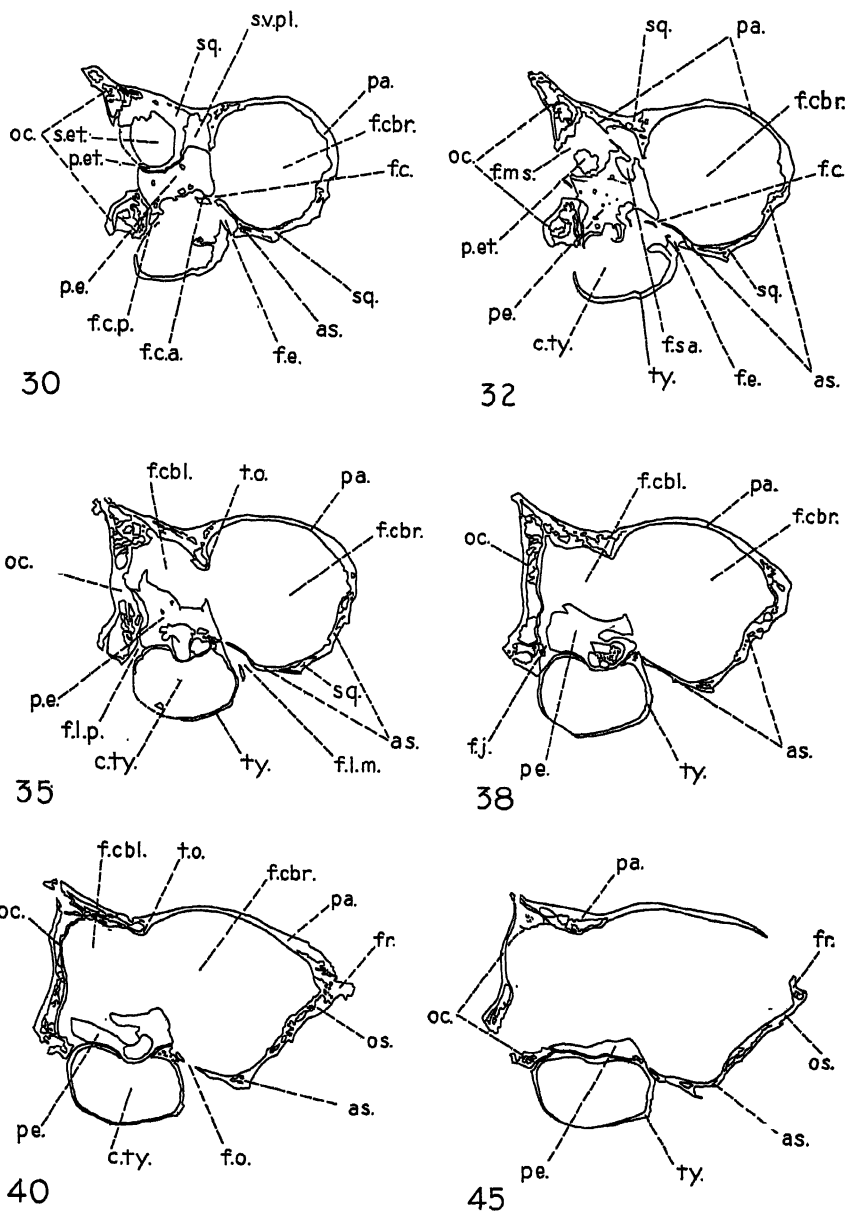


Fig. 6. *Oldfieldthomasia*. Parasagittal sections of cranium. The numbers correspond to those of the complete series of sections, see text. The right side is anterior. For abbreviations see p. 29. Natural size.

The structure of the exposure of the periotic in the tympanic cavity is discussed below.

The course of the entocarotid artery is not shown with complete clarity and while the following observations seem highly probable they are not certain. This vessel apparently enters the tympanic cavity through a very small foramen, entirely in the tympanic, opening into the fissure between the posterior edge of the bulla and the paroccipital process, immediately medial to the more produced part of the latter, and lateral to the foramen lacerum posterius, which is included in the medial extension of the same fissure. The course of the entocarotid from this point within the bulla cannot be followed, not being clearly impressed on any osseous part, but presumably it traversed the bulla around (medial

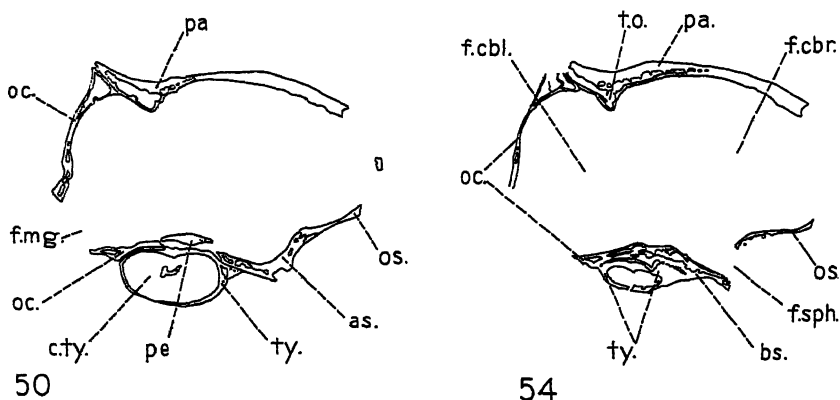


Fig. 7. *Oldfieldthomasia*. Parasagittal sections of cranium. The numbers correspond to those of the complete series of sections, see text. The right side is anterior. For abbreviations see p. 29. Natural size.

to) the promentorium. In section 31, immediately lateral to the promentorium, a groove appears below and anterior to the last trace of the latter, immediately anterior to what is rather surely the sulcus facialis, which is in all probability a sulcus caroticus, and this is seen in the same section (also in 30 to 32) to run anteriorly into a foramen. The roof, lateral wall, and floor of this foramen are formed by the periotic, the latter by a small reflected process from near the base of the processus perioticus superior. The medial wall is formed by the edge of the tympanic, which here rises to abut against the anteroinferior angle of the body of the periotic (section 33 and all medial to that). It seems sufficiently probable, although not certain, that this foramen is the foramen

caroticum anterius. Although the course of the carotid within the bulla cannot have been straight, this anterior foramen is almost exactly anterior to the probable foramen caroticum posterius, both appearing in the same section (31). It opens into the large fissure anterolateral to the bulla, above the canalis tubarius, and lateral to the foramen ovale. The artery did not course for any distance along this fissure, however, for immediately anterior to the probable foramen caroticum anterius and scarcely separated from it is a foramen between the periotic and the alisphenoid, into the posterobasal part of the cerebral fossa which must (if other indentifications here made are correct) be the (true or primary) foramen caroticum.

In any case it is certain that the entocarotid does not in this genus, as it does in *Hegetotherium* and some other notoungulates, pass between the tympanic and periotic on one side and the basioccipital and basisphenoid on the other, wholly outside the tympanic cavity.

The eustachian tube apparently left the bulla through the gap (prominent in section 30) immediately below the reflected periotic process flooring the foramen caroticum anterius, between this and the tympanic, and entered a short, oblique canalis tubarius running downward, forward, and medially, between the tympanic and the alisphenoid. This opens inferiorly along the fissure on the anterolateral edge of the bulla, posterolateral to the foramen ovale, and well removed from the anterior point of the bulla. There is no styliform process. This arrangement is apparently primitive for notoungulates, but in many later forms the tube, after emerging, channeled the outer surface of the bulla nearly or quite to its anterior end and a styliform process often developed. In some cases (possibly in *Protypotherium*, for instance) the channel may even have become a closed canal in the tympanic, but the material available to me does not absolutely prove this.

The epitympanic recess has the form of a nearly cylindrical meatus from the tympanic cavity into the epitympanic sinus. Its mouth is visible in section 25, opening in the extreme superolateral part of the cavity, above the inner end of the external auditory meatus. Thence it runs externally (in reverse order of numbering sections) and upward. Section 24 is near the outer edge of the opening into the tympanic cavity, and the inner part of the opening into the epitympanic sinus is just appearing. In 22 the canal is above the inner end of the auditory meatus, from which it is here completely separated by a bony wall, and widely open into the epitympanic sinus, appearing as a groove on the floor of the latter. This groove disappears at about section 19,

which is at the midpoint of the sinus (midpoint from side to side).

The epitympanic sinus is well developed, as it is in all notoungulates. It has approximately the size, and somewhat the shape, of the bulla, being egg-shaped, with its larger end directed downward and forward. Above the external auditory meatus the floor of the sinus, formed by the thick roof of the meatus, is bowed upward. Following the sections toward the midline, this irregularity disappears and the opening into the epitympanic recess, already described, appears. Aside from these features, the wall of the cavity is very simple and smoothly concave. The wall is somewhat cracked and broken, especially the more lateral parts, so that the absence of other openings cannot be positively affirmed, but none can be surely identified and any present must have been small and insignificant.

#### PERIOTIC

Almost every detail of the complex and interesting periotic bone is revealed by the serial sections of the cranium which forms the chief subject of this study, and the principle surface features are also visible in Santa Cruz specimens of *Hegetotherium* and of *Protypotherium* incidentally examined.

The outer form of the bone is very complex, but without marked differentiation into distinct elements. The central mass comprises the pars vestibularis s. canaliculus, which is more posteroexternal and is the principal part cut by sections 27-33, and the pars cochlearis, which is more anterointernal and forms the greater part of sections 38-42, the sections between these showing both about equally.

The posterior part of the bone is exposed over a small area on the occiput (limited by dotted lines in section 29-33). It is clear that the exposed part is practically undifferentiated from the pars canaliculus and represents no marked projection of the bone. Descriptively this is a pars mastoidea, very poorly developed. It is, of course, impossible to determine in a fossil whether a separate center of ossification is really represented, nor is it of any great consequence. The important points are that the mastoid region is poorly developed, uninflated, surely has nothing to do with the epitympanic sinus (not even being exposed in the floor of the latter), and develops no true processus mastoideus. These characters seem to be common to all notoungulates, as far as I can surely determine. In *Oldfieldthomasia*, at least, this small occipital exposure is the only point at which the periotic is visible externally in an undamaged skull. In other cases even this small exposure may occur in so deep

and narrow a cleft as to be practically invisible from the outside.

The periotic is produced medially into a thin sharp crest loosely over-

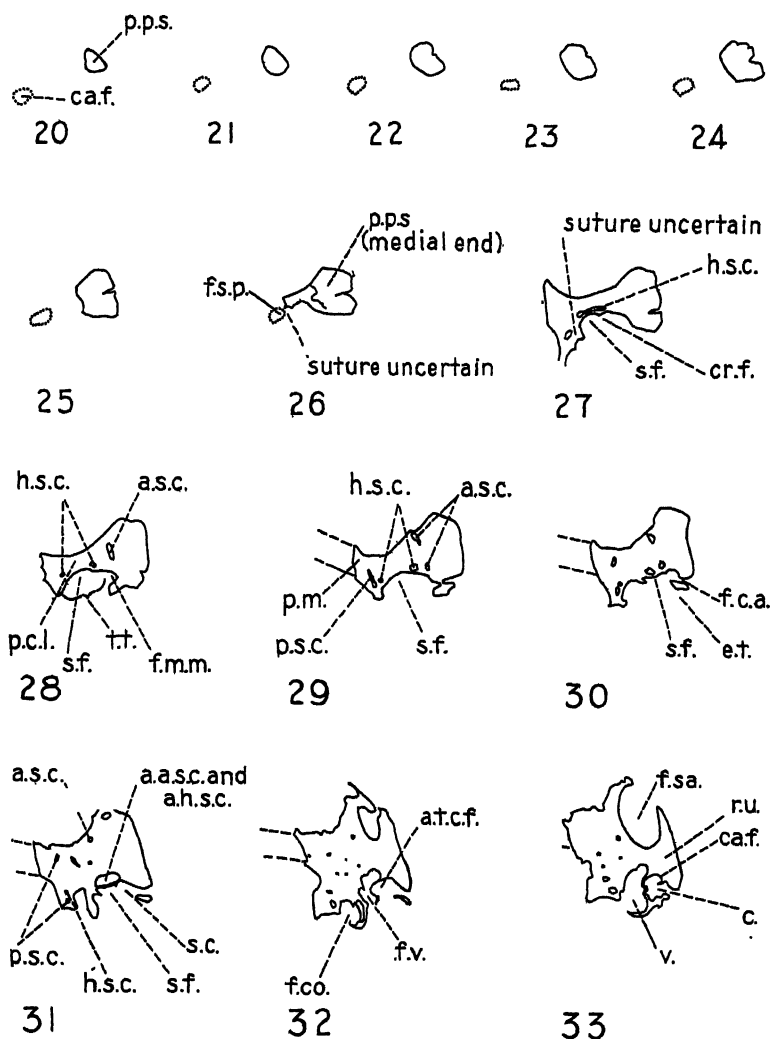


Fig. 8. *Oldfieldthomasia*. Parasagittal sections of periotic. The numbers correspond to those of the complete series of sections, see text. The right side is anterior. In sections 20 to 26 the facial canal is not in or on the periotic, but its position is shown by dots. In sections 29 to 33 the two broken lines delimit the portion of the mastoid exposed on the occiput. For abbreviations see p. 23. One and one-third times natural size.



lying the inner edge of the tympanic (the bulla), from which it departs far enough to leave a noticeable gap. The basioccipital and basisphenoid here separate and leave a gap beneath the periotic, so that although the latter tends to overlap them it is no more than barely in contact with them at any point and they do not really separate the periotic from the tympanic. The medial periotic surface above this crest is a sloping, simple surface with few features beyond the internal auditory meatus and the fossa subarcuata. The latter is broad and shallow, much less pronounced than in *Protypotherium*, for instance. The anterior surface, which abutted against the pyriform lobe of the cerebrum, is approximately triangular in plan, nearly plane, and slopes upward and backward.

The inferior, or inferolateral, surface has on its medial and postero-medial parts a large nearly smooth surface which is more or less closely applied to the corresponding part of the tympanic here roofing the bulla. Lateral to this, nearly in the middle of the inferior periotic face but nearer its anterior border, the strong, swollen promontorium appears. It is inserted in one side of the tympanic gap, and so is exposed in the tympanic cavity. On the lateral side of this appear the several openings into the middle ear, discussed below, and above these the shelflike projection of the prominentia canalis lateralis, which reaches to the edge of the epitympanic recess, and the lower surface of which forms the tegmen tympani.<sup>1</sup> From the anterolateral point of the main body of the periotic arises a strong, conical or styliiform process, over 2 mm. in length, which extends almost straight laterally along the floor of the posterolateral cerebral venous sinus. This is at least analogous to a processus perioticus superior, and I have so designated it. Its relations are well shown in section 20, the most lateral section showing it, and in section 25, which is immediately lateral to its merging with the main body of the periotic. In the latter, the anterior face of the process shows a deep fissure, also visible in 24 and 26-28, which is not shown by the sections to be the mouth of a canal, and the function of which I do not know.

Turning to the internal structure of the periotic, the course of the facialis nerve is shown clearly. It enters, as usual, by the internal auditory meatus, where an upper groove for it is first (in proceeding from the midline) seen clearly in section 40. In 39, where the meatus is enclosed, this is a marked superoanterior pocket, and in 38 it becomes a separate canal above the cochlear cavity, into which the duct of the auditory

<sup>1</sup> Commonly so-called, but not entirely analogous to the part so designated in human anatomy, which is the roof of the epitympanic recess. In *Oldfieldthomasia* the periotic reaches the recess but forms no significant part of its walls, so that a tegmen tympani in the human sense is lacking.

nerve has now entered. In the same section the canalis facialis shows a branch that runs straight forward and opens into the cerebral cavity. This is clearly the hiatus canalis facialis for the nervus petrosus super-

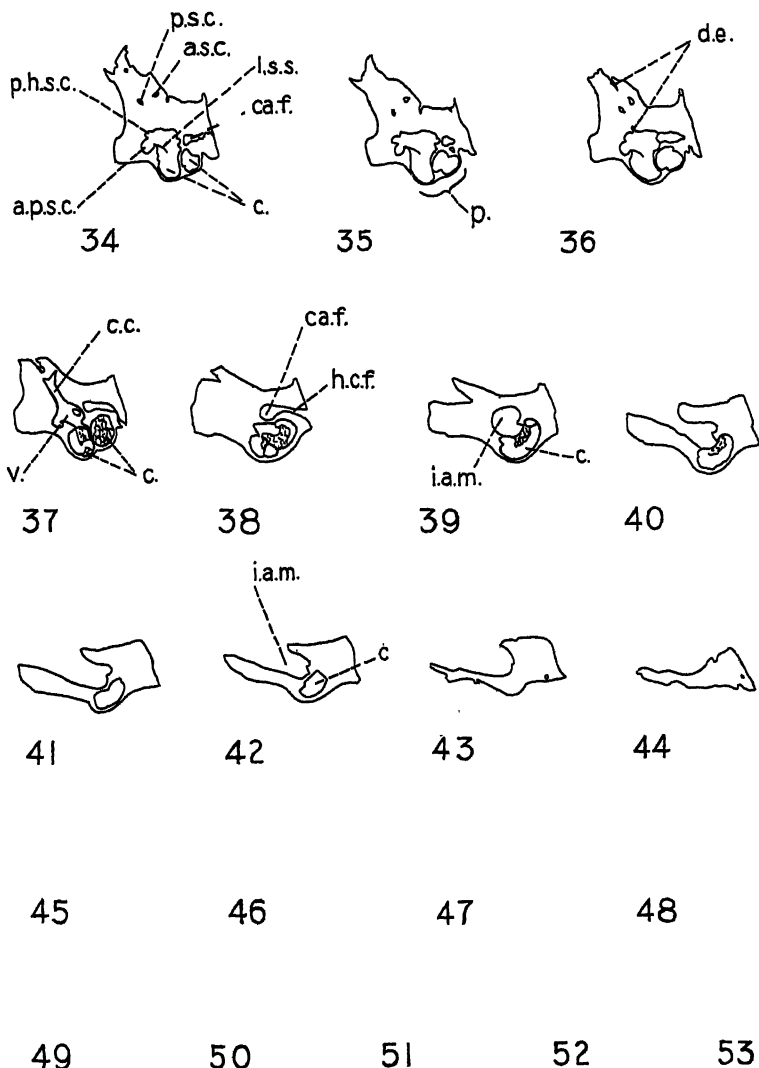


Fig. 9. *Oldfieldthomasia*. Parasagittal sections of periotic. The numbers correspond to those of the complete series of sections, see text. The right side is anterior. For abbreviations see p. 23. One and one-third times natural size.

facialis major. The canalis facialis, proper, continues internally above the anterior part of the cochlea and anterior to the vestibule, from which it is at times separated only by a very thin film of bone, and finally in section 32 emerges into the tympanic cavity through the apertura tympanica canalis facialis, immediately anterior to the fenestra vestibuli. It crosses the roof of the tympanic cavity in a shallow open groove, running at first a little laterally, then almost straight posteriorly. Section 29 is cut almost along this part of the sulcus facialis and most of the lower margin of the periotic in this section was probably underlain by the facialis. At the edge of the periotic, in section 27, the facialis is in a more pronounced groove, and here turns and runs more externally, leaving the periotic and, section 26, entering another canal through the foramen stylomastoideum primitivum. Although now beyond the periotic, its further course may be followed. It continues in this canal, which is in the unidentified posteroinferior ?squamosal element near its suture with the tympanic, and passes laterally through the bone above and very slightly anterior to the vagina processus hyoidei. It then bends very slightly backward, and then emerges at the stylomastoid foramen, immediately below and behind the porus acusticus and lateral to the vagina processus hyoidei.

The angle between the planes of anterior and posterior semicircular canals is approximately  $85^{\circ}$ , between those of anterior and horizontal canals about  $90^{\circ}$ . The other characters of the semicircular canals are well shown in the sections, and present no notable peculiarities.

In section 36 a canal is seen to leave the superoposterior part of the vestibule, and a canal is seen (as also in 37) entering the cerebellar cavity posterior to the fossa subarcuata. The canal being of smaller diameter than the section distance, 0.4 mm., its intermediate portion is lost and was not noticed when the section was ground, but it is probable that these are the two ends of the same canal and that it is for the ductus endolymphaticus. In section 31 another extremely small canal is seen in the area between the various sections of the semicircular canals. Between 30 and 31 this was seen to continue in the direction of its long diameter in 31 and to open into the small gap between the petrosal and the wall of the epitympanic sinus, but its lower end could not be followed. Aside from a few extremely minute holes, barely visible under a binocular (e. g., in section 32), which seem merely to be slight defects in ossification or traces of cancellous structure, no other small canals were observed.

The cochlea and vestibule are well shown in the sections and seem to

present no marked peculiarities. The sections do not suffice to determine the number of turns of the cochlea, but apparently there were few, perhaps less than two, although a skull of *Hegetotherium*, broken so that the cochlea lies partly open, apparently has  $2\frac{1}{2}$  turns, as in most ungulates. The fenestra vestibuli and f. cochleae are not very clear, since their rims are nearly in the plane of the section and the bone is very thin, but by superposing the sections as transparencies their character can be made out. The fenestra vestibuli is smaller than the fenestra cochleae and is elongate in an anteroinferior-posterosuperior direction, while the fenestra cochleae is more nearly circular although slightly elongate in the same direction. They are separated by a thin bridge of bone. In one section (32) the fenestra cochleae, fenestra vestibuli, and apertura tympanica canalis facialis may be seen arranged in a row from postero-inferior to anterosuperior, in the order named, separated by thin bony plates, appearing here as grooves since their lips are more medial.

The fossa muscularis major, for the tensor tympani, is well defined and easily recognizable, particularly in section 28, as a pocket, extending forward and upward, lateral to the apertura tympanica canalis facialis and internal to the epitympanic recess. It lies immediately above the posterior end of the canalis tubarius, from which it is, however, quite separate, and immediately lateral to and slightly above the (probable) foramen caroticum anterius.

The last named foramen, described in dealing with the bulla, is the only other important structure involving the periotic.

#### ABBREVIATIONS ON PERIOTIC SECTIONS

- a.a.s.c., ampulla of anterior semicircular canal.
- a.h.s.c., ampulla of horizontal semicircular canal.
- a.p.s.c., ampulla of posterior semicircular canal.
- a.s.c., anterior semicircular canal.
- a.t.c.f., apertura tympanica canalis facialis.
- c., cochlea.
- ca. f., canalis facialis.
- c.c., crus commune.
- cr. f., crista facialis.
- d.e., ductus endolymphaticus(?).
- e.t., eustachian tube.
- f.c.a., foramen caroticum anterius.
- f.co., fenestra cochlearis.
- f.m.m., fossa muscularis major.
- f. sa., fossa subarcuata.
- f.s.p., foramen stylomastoideum primitivum.
- f.v., fenestra vestibuli.

h.c.f.,	hiatus canalis facialis.
h.s.c.,	horizontal semicircular canal.
i.a.m.,	internal auditory meatus.
l.s.s.,	lamina spiralis ossea.
p.,	promentorium.
p.c.l.,	prominentia canalis lateralis.
p.h.s.c.,	posterior opening of horizontal semicircular canal.
p.m.,	pars mastoidea.
p.p.s.,	processus perioticus superior.
p.s.c.,	posterior semicircular canal.
r.u.,	recessus utriculi.
s.c.,	sulcus caroticus.
s.f.,	sulcus facialis.
t.t.,	tegmen tympani.
v.,	vestibule.

#### EXTERNAL FORAMINA

The *optic foramen* is not preserved in this specimen.

The *sphenorbital foramen* is more on the inferior than on the lateral side of the cranium and is unusually close to the anterior margin of the bulla, although this may be accentuated to a small degree by breakage of the foramen wall.

A rather large, elongate fissure at about the middle of the antero-lateral border of the bulla, and hence distinctly external in position represents the *foramen lacerum medium*. As shown by the internal structure, its more anteromedian end is the foramen ovale, its more posterolateral the eustachian foramen, and above the latter is the true carotid foramen which, however, does not appear at all externally.

There are no foramina at the anterior or posteromedian ends of the bulla or along its median border.

A distinct but small and irregular *fissura glaseri* is visible medial to the glenoid surface, anterior to the crista meati, at the external angle of the bulla.

The sections show that there are several postglenoid canals, but their external relationships are obscured by breakage. All are analogous in structure and function. The opening of the largest, which is the (or the principal) *postglenoid foramen* is between the glenoid surface and the porus acusticus externus, appearing as a vertical channel between postglenoid process and crista meati before it turns and runs into the bone in an anteromedian direction.

The *porus acusticus externus* is described in connection with the auditory chambers.

The *stylomastoid foramen*, which is directed laterally rather than in-

teriorly, is immediately posteroinferior to the porus, from which it is separated by a bony wall, and directly above and lateral to the vagina processus hyoidei.

The *vagina processus hyoidei* (which, of course, is not properly a foramen, having an unperforated roof) is a relatively large and deep pit in the usual notoungulate position, that is, at the posterolateral angle of the bulla. Its anteromedian wall is formed by the bulla, anterolateral by the inner end of the posterior crest of the crista meati, posterolateral by a small bridge of bone joining the crista meati and posttympanic process below the stylomastoid foramen, and posteromedian by the external part of the paroccipital process. On the unsectioned half of the skull there is a circular opening at the posterior edge of the vagina processus hyoidei which appears to be a foramen, but from the sections it appears without much doubt that this is merely a break exposing the cancelli of the adjacent bone.

A deep, narrow, vaguely double fissure on the posterior border of the bulla, between the latter and the median part of the paroccipital process, is the *foramen lacerum posterius*, which, like the f. l. medium, is thus displaced laterally with respect to the more usual position. The more lateral part of the fissure was apparently entered by the entocarotid and contains, on its anterior wall and scarcely visible externally, the foramen caroticum posterius, while the more median and more open part is the foramen jugulare.

The *hypoglossal* (or *condylar*) *foramen* is broken away on the sectioned half, and only partly preserved on the unsectioned portion. On the latter it may, however, be seen that it was relatively large, freely exposed, and approximately circular. Its opening forms a pit immediately posterior to the most posterior (posteromedian) point of the bulla, whence the canal runs upward, backward, and medially. There is a small circular opening on the anterior wall of the pit which may, however, be an artifact.

The margins of the *foramen magnum* are broken. In another specimen of *Oldfieldthomasia* it is preserved, but presents no marked peculiarities, being a simple transverse ellipse with a large, rounded basal notch.

A small opening which may be at least descriptively accepted as a *mastoid foramen*, is left by the incomplete filling of the gap on the occiput of the pars mastoidea. This opens into a channel posteromedian to the epitympanic sinus and above the pars mastoidea, opening into the posterolateral part of the cerebellar fossa.

There are several small and variable *venous foramina* on the roof of

the skull in the squamosal and parietal near their suture with each other, and at least one in the anterolateral cerebral wall.

#### POSTGLENOID, POSTTYMPANIC, AND PAROCCIPITAL PROCESSES

These processes are very incomplete on both sides of the sectioned skull, but are fairly well shown by another skull of the same genus.

The postglenoid process is large and prominent, compressed antero-posteriorly. Its lateral end passes into a ridge which runs upward and then curves backward, forming a semicircular eminence anterior and superior to the porus acusticus. The median end abuts against the middle of the anterolateral side of the meatus, being separated from the crista meati by a notch, which continues posteriorly and then superiorly as the groove running into the postglenoid foramen.

A posttympanic process is usually present as a morphological element in notoungulates, being a downward projection of the squamosal or of the "posterior adventitious bone," but in most cases it is applied to the side of the paroccipital process and is not topographically separate from the latter. In *Oldfieldthomasia*, however, or at least in skull Amer. Mus. No. 28896, it has a distinct apex, lateral to the paroccipital process and much less prominent than the latter. The paroccipital process, formed entirely by the exoccipital, is very prominent, directed straight downward, and apparently was simply styliform (the end is broken on all available specimens). In any case it clearly had no striking specialization such as, for instance, that of *Pachyrhinos*.

#### ENDOCRANIUM

I have elsewhere (Simpson 1932) described an imperfect natural braincast of *Oldfieldthomasia* which showed the more essential dorsal features of the cerebrum and olfactory bulbs. The present specimen adds nothing to knowledge of the various sulci and convolutions, the direction and thickness of the sections not being suitable for this purpose, but it clearly shows the positions of all the cranial nerves save I and II, the general proportions of the postolfactory parts of the brain, and some other details.

The general plan is clearly identical with that of *Notostylops* (Simpson 1933A), the differences being slight and of degree only. The indicated braincast might be summed up as intermediate between *Notostylops*, more primitive in this respect, and *Hegetotherium* (Simpson 1933B), more advanced, but nearer the former.

The pyriform lobes were somewhat deeper and less expanded pos-

teriorly than in *Notostylops*, but had not or had not so markedly expanded inferoanteriorly as in *Hegetotherium*. The dorsal gap between cerebrum and cerebellum prominent in *Notostylops* does not exist in *Oldfieldthomasia* (see section 54, where the crested tentorium sharply divides the two fossas dorsally), but the dorsal part of the cerebellum is still fully exposed and on a level with the cerebrum, not depressed below and partly overlapped by the cerebrum as in *Hegetotherium*. The endocranial foramina are almost exactly as in *Notostylops*, except that the internal ends of the foramina lacera anterior and medium were somewhat nearer to each other and that of the hypoglossal is not shown to be (but may nevertheless have been) double.

In the vicinity of the fossa of sylvius a small canal, evidently vascular, leaves the endocranial cavity, runs for some distance anteromedially in the bone, and then opens on the outer surface. It may be seen, near its internal origin, in section 35, and its anterior opening is in section 41. This is probably the homologue of the large anterior cerebral vessels of *Rhyphodon*, and although variable, one or more such vessels seem to be the rule in notoungulates as they are seen in almost all the skulls, well preserved in this region, that I have examined.

Special interest attaches to the posterolateral cerebral venous openings which I have previously shown (1933A, B) to be characteristic of notoungulates, although apparently not invariable as they were not detected in *Rhyphodon*. They are very well developed in *Oldfieldthomasia*, and their structure is fully shown by the sections.

In section 32, where there is still a large lumen in the cerebral region (chiefly the pyriform lobe), the cerebellar fossa, proper, is ending and the first small slice of the medial wall of the epitympanic sinus appears in its place. In the anterosuperior part of the periotic is an embayment which represents the fossa subarcuata. Above this is a space which represents an anterolateral continuation of the cerebellar cavity, and is here nearly cut off from the cerebral cavity. Laterally, in reverse order through sections 31 to 27, this continues as a large sinus, quadrate in section, bounded anteriorly by a lateral continuation of the tentorium, ventrally by the periotic, posteriorly by the wall of the epitympanic sinus, and dorsally by the skull roof (here squamosal). Its roof contains several foramina which communicate with the internal vessels and diploe of the skull roof. At least one canal (sections 26-24) also runs from outside the skull roof, through the latter along the squamoso-parietal suture, and into the sinus. In sections 26 to 23, the anteroventral part of the sinus is widely open into the cerebral cavity, here cut in its extreme postero-



lateral part. This is clearly the prominent foramen that I have described in several related genera from its trace on the braincase. External to this, the sinus becomes an encircled pocket of irregular oval shape, with the processus perioticus superior inserted in its floor and finally, about section 15, narrows and becomes a large canal which passes out laterally above the glenoid fossa, then turns downward and backward and emerges in the postglenoid foramen. There are also in this lateral region, poorly preserved in this specimen, several other smaller vascular canals, one or more of which also communicate with this sinus, which is connected with a general postglenoid venous drainage.<sup>1</sup>

#### NOTE ON A SPECIMEN OF *PLEUROSTYLODON*

Patterson has described the external features of the ear region of *Pleurostyodon* in a paper in press, of which he kindly gave me a duplicate manuscript. Another specimen of this genus, Amer. Mus. No. 28878, is broken in this region, but the parts present are unusually well preserved and show some of the external characters even more clearly than

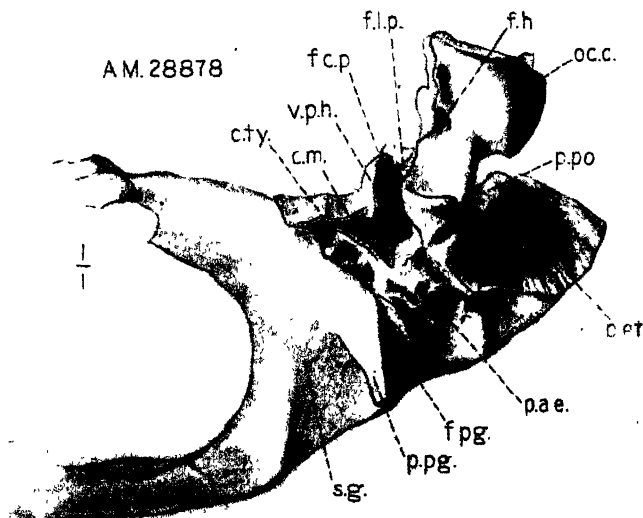


Fig. 10. *Pleurostyodon*. Ventral view of part of right half of cranium. For abbreviations see p. 29. Natural size.

<sup>1</sup>skull fragment from the Desado beds there are at least five postglenoid foramina, all uniting eventually in the sinus. In most forms there is one, usually prominent.

does Patterson's specimen, while the very fact and nature of the breakage reveal some important internal structures. Although irregular, the fracture is essentially an oblique superolateral-inferomedial section and reveals the inner faces of the outer walls of the epitympanic sinus, upper part of the tympanic cavity, foramen magnum, and posterolateral part of

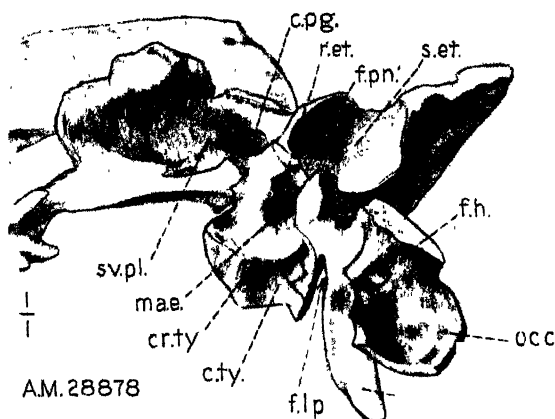


Fig. 11. *Pleurostylodon*. Medial aspect of the external part of the right side of the cranium. For abbreviations see text, below. Natural size.

the cerebral cavity. The figures are self-explanatory, in conjunction with the preceding description of the same parts in *Oldfieldthomasia*, which is closely similar in this region and the description and sections of which are, I believe, clarified and made easier to follow by the present figures.

#### ABBREVIATIONS ON FIGURES

(Abbreviations on the sections of the petrotic, alone, are given separately on a previous page.)

as.,	alisphenoid.
bs.,	basisphenoid.
ca.f.,	canalis facialis.
c.m.,	crista meati.
c.pg.,	postglenoid canal.
cr. ty.,	crista tympanica.
c.ty.,	tympanic cavity.
f.c.,	carotid foramen.
f.c.a.,	foramen caroticum anterius.
f.cbl.,	cerebellar fossa.
f.cbr.,	cerebral fossa.

- f.c.p., foramen caroticum posterius.  
 f.e., eustachian foramen and canal.  
 f.g., fissura glaseri.  
 f.h., hypoglossal foramen.  
 f.j., foramen jugulare, and canal.  
 f.l.m., foramen lacerum medium.  
 f.l.p., foramen lacerum posterius.  
 f.mg., foramen magnum.  
 f.ms., mastoid foramen.  
 f.o., foramen ovale.  
 f.pg., postglenoid foramen.  
 f.pn., foramen pneumaticum (of epitympanic sinus).  
 fr., frontal.  
 f. sa., fossa subarcuata.  
 f.sm., stylomastoid foramen.  
 f.sm.p., foramen stylomastoideum primitivum.  
 f.sph., sphenorbital foramen.  
 f.v., venous foramina and canals, not especially named.  
 f.v.pl., posterolateral cerebral venous foramen.  
 m.a.e., external auditory meatus.  
 oc., occipital (all elements, fused).  
 oc.c., occipital condyle.  
 os., orbitosphenoid.  
 pa., parietal.  
 p.a.e., porus acusticus externus.  
 pe., periotic.  
 p.et., pars epitympanica (of squamosal).  
 p.m., pars mastoidea (of periotic).  
 p.pg., postglenoid process.  
 p.po., paroccipital process (broken base in figures of *Oldfieldthomasia*).  
 p.pt., posttymppanic process (broken base in figures of *Oldfieldthomasia*).  
 r.et., epitympanic recess.  
 s.et., epitympanic sinus.  
 s.g., glenoid surface.  
 sq., squamosal.  
 s.v.pl., posterolateral venous sinus.  
 t.o., tentorium osseum.  
 ty., tympanic (including entotympanic, if any).  
 v.p.h., vagina processus hyoidei.  
 Xa., "anterior adventitious element."  
 Xp., "posterior adventitious element."

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# AMERICAN MUSEUM NOVITATES

Number 825

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

March 14, 1936

56.9, 1 M:14.31.4

## A SPECIMEN OF THE UPPER CRETACEOUS MULTITUBERCULATE *MENISCOËSSUS*

BY GEORGE GAYLORD SIMPSON

Numerous isolated mammalian teeth have been discovered in the American Upper Cretaceous, but associated teeth or jaws are extremely rare. A hitherto undescribed specimen, Amer. Mus. No. 22708, includes  $P_4$ ,  $M_1$ ,  $M_2$ , the root of  $P_3$ , and much of the bone of the left lower jaw of the multituberculate *Meniscoëssus*. It is far the best multituberculate specimen yet to be discovered in the American Cretaceous and is of great interest on that account and as providing conclusive evidence of the generic association of isolated teeth hitherto collocated on more theoretical grounds.

The specimen was found by Miss Idella Kennedy thirty-five miles southwest of Ekalaka, Montana, Sec. 9, T. 1S., R. 55E., in Hell Creek beds at a horizon designated as about 400 feet below Fort Union lignite beds. It was presented to the Museum by the Carter County Geological Society, through Mr. W. H. Peck of that Society.

The accompanying drawings are by Mrs. Mildred Clemans.

In 1889 Marsh named, described, and figured several multituberculates from the Lance ("Laramie"), among them *Dipriodon robustus* (genotype), based on a tooth identified as the last left upper molar (now known to be right  $M_2$ ), *Dipriodon lunatus*, based on a tooth identified as left  $M^1$  or  $M^2$  (now known to be right  $M_1$ ), and *Halodon sculptus* (genotype), based on a tooth correctly identified as a last lower premolar. In 1893 Osborn recognized these genera, and three others based on lower incisors and upper teeth, as synonymous with each other and with *Meniscoëssus* Cope and although he still had only isolated teeth he made a hypothetical composition of the dentition.

Osborn's study showed remarkable insight in interpreting such fragmentary materials, and one of the interesting features of the present specimen is that it absolutely proves, for the first time, associations of teeth deduced by Osborn forty-two years ago.

In my study of Lance mammals (Simpson 1929), I accepted Osborn's collocations, pointed out the impossibility of any specific revision on

the materials then known, and included all the Wyoming, Niobrara County, *Meniscoëssus* in one species, *M. robustus* (Marsh), as inseparable although not of proven specific synonymy.

The question of the synonymy of Marsh's various specific names for forms now referred to *Meniscoëssus*, nine in all, is not much advanced

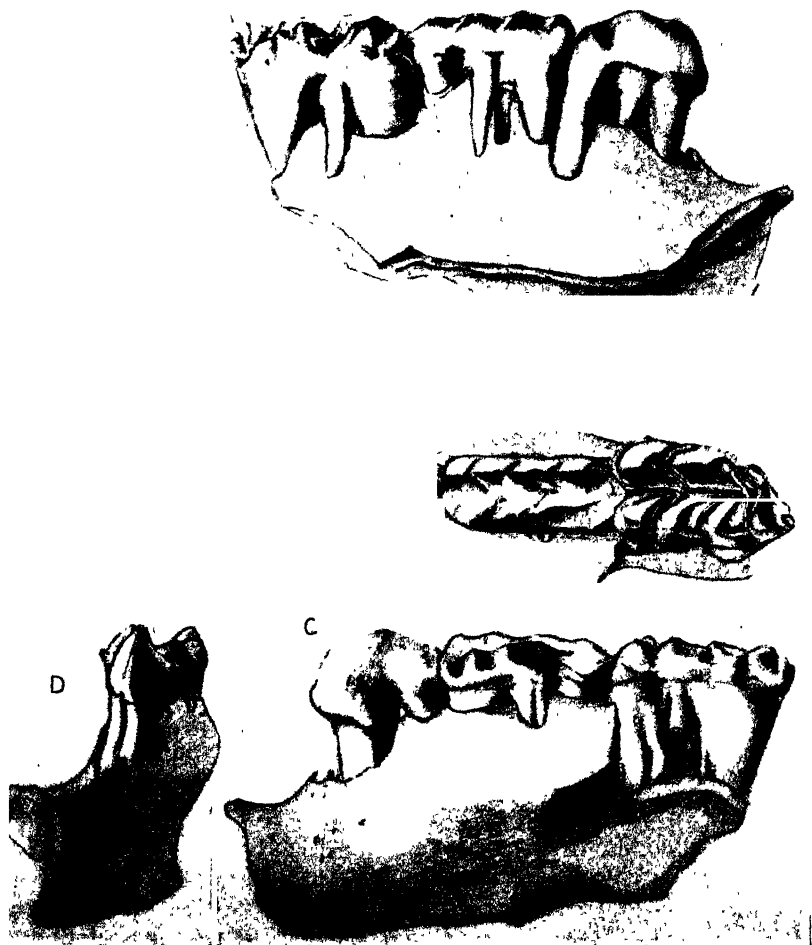


Fig. 1. *Meniscoëssus* sp. Amer. Mus. No. 22708, left lower jaw with  $P_4$ - $M_2$  and root of  $P_3$ . A, internal view. B, crown view. C, external view. D, anterior view. All three times natural size.

by this specimen, and indeed it is doubtful whether these species can ever be properly revised on a positive and direct basis. This specimen is directly comparable only with the types of the three species mentioned above, *robustus*, *lunatus*, and *sculptus*. From the first named it differs in having  $M_2$  nearly as long but markedly narrower. It shows no certainly ascertained differences from the other two, but the preservation is not good enough to warrant the positive conclusion that these two names are synonymous and apply to a species distinct from *robustus* and including the new Montana specimen. In any event the three species are shown to be certainly congeneric and closely related.

The morphology of the separate teeth has already been described in some detail by Marsh, Osborn, and me, and the present specimen adds little of interest in this respect. It is, moreover, well worn, and the surfaces of  $P_4$  and  $M_1$  are corroded or abraded so that their superficial details are not reliable. One point of interest, long known to

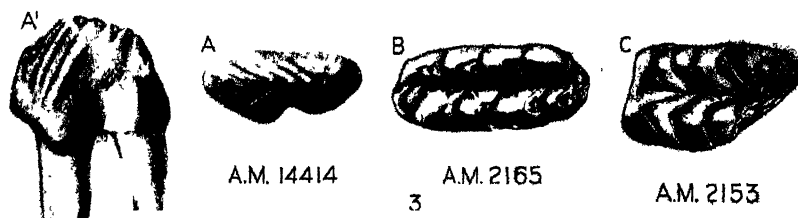


Fig. 2. *Meniscoëssus* sp. Isolated teeth from the Lance of Niobrara County, Wyoming, for comparison with the corroded, less well preserved, but associated teeth shown in Fig. 1. A, Amer. Mus. No. 14414, left  $P_4$ , crown view. A', same, external view. B, Amer. Mus. No. 2165, left  $M_1$ , crown view. C, Amer. Mus. No. 2153, right  $M_2$ , crown view. All three times natural size.

students of multituberculates but not very carefully described in publications is well shown in this specimen: the supernumerary roots of the cheek teeth. Each tooth (except the vestigial  $P_3$ ) is implanted by two stout roots, one anterior and one posterior, each extending the entire width of the base of the crown, but each tooth also has one or more much smaller, cylindrical roots. On  $P_4$  there is only one accessory root, in the middle of the internal side. On  $M_1$  there are two external and two internal accessory roots, and on  $M_2$  one internal and two external.



but one of the latter is imperfectly separated from the main anterior root.<sup>1</sup>

The proportions of  $P_4$ - $M_2$  have not previously been available for any one individual and are very typical in *Meniscoëssus*.  $P_4$  is shorter than either  $M_1$  or  $M_2$ ; in most ptilodontids it is considerably longer than either.  $M_1$  is very slightly longer than  $M_2$ ; in most ptilodontids it is relatively much longer, often twice as long as  $M_2$ .  $M_2$  is wider than  $M_1$ , which is true of most or all ptilodontids but often in less degree.

Osborn (1893) and Osborn and Earle (1895) suggested a close, possibly ancestral relationship between *Meniscoëssus* and the Puerco genus *Taeniolabis*. Granger and Simpson (1929) opposed this view, showing that *Meniscoëssus* is closer to the true ptilodontids and cannot be the ancestor of *Taeniolabis*. The present improved evidence strongly supports this view. *Meniscoëssus* is a ptilodontid with no definitely taeniolabidid characters. It is, however, an isolated genus among Ptilodontidae. Among other characters of *Meniscoëssus*, its relatively small  $P_4$  and relatively large  $M_2$ , the strongly selenodont molar cusps, and the laterally compressed, pointed, completely enameled incisor crown (assuming the collocation made by Osborn to be correct, not yet proven but highly probable) do not resemble any known Paleocene or Eocene genus and almost exclude the possibility of deriving any of the later forms from *Meniscoëssus*. It appears to be a specialized, aberrant Cretaceous ptilodontid. It is perhaps conceivable that a special relationship to some of the poorly known *Eucosmodon*-like forms does exist, but no positive evidence supports this and it is improbable.

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<sup>1</sup> Adherents of the moribund concrescence theory of molar evolution, and perhaps of some other theories, may be tempted to hail these multiple roots as significant support for their views. Without going into detail here, it may be noted that I have studied multituberculate (and other mammalian) roots with care, and that there is no doubt that the condition with just two roots on lower cheek teeth is primary, multiple roots secondary and specialized and that root number and arrangement do not reflect in any direct or simple way the number and arrangement of the cusps.

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SKELETAL REMAINS AND RESTORATION OF EOCENE  
ENTELONYCHIA FROM PATAGONIA<sup>1</sup>

BY GEORGE GAYLORD SIMPSON

The skeleton of South American ungulates has been practically unknown for any stage before the Deseado, and knowledge of the crucial early evolution of these groups has been derived from teeth and a very few skulls. The only exceptions are some isolated bones, a humerus ascribed to *Notopithecus* and several astragali ascribed to various genera, described by Ameghino. Even these exceptions, valuable as they are, are not very enlightening, being single unassociated bones of uncertain systematic position.

The Scarritt Expeditions were peculiarly fortunate in finding several partial skeletons in the Casamayor formation which reveal almost the entire structure in the Entelonychia of this very early stage, as well as limited parts of the skeleton in some other groups. Full description is deferred for a monograph of the whole fauna now well advanced, but it has become necessary to publish this preliminary and summary note in order not to impede the work of other students.

The accompanying reconstruction and restoration were drawn by Mrs. Mildred Clemans, 1935, under my direction.

The three principal specimens here briefly recorded are the following:

A.—Amer. Mus. No. 28905. Including most of the vertebrae from the atlas to the anterior caudals, nearly complete right fore-limb, left pelvis and femur, many ribs and other fragments. The genus is certainly *Thomashuxleya*. Fragments evidently of the skull of the same individual were found nearby. They were too extremely disintegrated to be worth restoration or even collecting, but permitted certain field identification as a species of *Thomashuxleya* of which several nearly complete skulls were found at the same horizon and locality. Furthermore this genus is there common and none other to which the skeleton could conceivably belong is known. Found by G. G. Simpson, 1930, in the Casamayor of the "Oficina del Diablo," Cañadón Vaca, Chubut.

B.—Amer. Mus. No. 28906. Fourteen vertebrae, sternum, clavicle, most of both fore-limbs, ribs, and other fragments. The generic ascription is uncertain, but may be possible later. The skeleton is smaller than A, but generally similar. It may belong to a small species of *Thomashuxleya*, or to one of the ill-known and as yet unre-

<sup>1</sup> Publications of the Scarritt Expeditions, No. 27.

vised genera of the same group which include species smaller than *Thomashuxleya* and larger than *Pleurostylodon*. In any event it is almost certainly an entelonychian. Found by C. S. Williams, 1931, in the Casamayor (slightly below the level of A but not appreciably different in age), Cañadón Vaca, Chubut.

C.—Amer. Mus. No. 28904. Left humerus, radius, and ulna, both femora and tibiae, numerous foot bones, one dorsal and several caudal vertebrae, ribs, and other fragments. The smallest skeleton of the three, almost surely of *Pleurostylodon*, as that is the commonest genus including species of this size and as the bones agree well with fragments found in actual association with *Pleurostylodon* skull and jaw fragments. Found by G. G. Simpson, 1931, in the Casamayor (same level as A), Cañadón Vaca, Chubut.

For brevity the three skeletons are described together and are referred to as A, B, and C. The structure is essentially the same in all, with differences apparently of not more than generic value.

Comparison is here made chiefly with *Homalodotherium* of the Santa Cruz, especially the skeleton found by the Field Museum party under Riggs and described by Scott (1930, see references). *Homalodotherium* represents the height of entelonychian specialization in the skeleton, as far as known,<sup>1</sup> and among the special points of interest of the Casamayor specimens are the demonstration of the origin of its peculiarities from a structure more normal, or more primitive, and indication of the degree of evolution in a single group from Casamayor to Santa Cruz time. Where the part is unknown in *Homalodotherium*, or to suggest special resemblances, some reference is also made to Santa Cruz typotheres as described by Sinclair (1909) and toxodonts as described by Scott (1912). More detailed comparisons are deferred.

VERTEBRAE.—The posterior dorsals, lumbar, sacrum, and anterior caudals were preserved in articulation in A, but breakage of the processes makes it uncertain exactly where the change from dorsal to lumbar occurs. There are certainly five and not more than seven lumbar, seven being the most probable number. There are preserved eleven to thirteen, probably eleven, dorsals, but as most of these were scattered a few may well be missing—judging from later notoungulates it is probable that there were about fifteen dorsals in the complete series. There are four sacra in A. B and C do not contribute to knowledge of the vertebral formula.

Six cervicals are preserved in A, the missing vertebra probably being the fifth, or possibly the sixth. The atlas considerably resembles that of *Nesodon*, but is less depressed dorsoventrally and has the transverse processes relatively much smaller. The axis has a large, peglike odon-

<sup>1</sup> Only one later form, *Chasicotherium*, has been described and in it the skeleton is unknown.

toid process. The transverse processes, although imperfectly preserved, were clearly much smaller than in *Nesodon* and the canal through each is diminutive. The neural spine is much less expanded than in *Homalodotherium* (although relatively slightly more elongate than in *Nesodon*) and its expansion is less anteroposterior, more anteroinferior-posterosuperior so that it extends relatively farther above the postzygapophyses behind and in a more pronounced point above the odontoid before. A prominent vertebrarterial canal is present on all the four other preserved cervicals of A, but of the three cervicals of B (all posterior to the axis) one, probably the last, lacks the canal.<sup>1</sup> In both specimens, so far as shown, the neural arches of vertebrae C 3-7 are similar, simple, with large normal zygapophyses and weak, simple neurapophyses directed slightly backward. The transverse process on C 3 of A has a short anteroinferior reflection forward and a prominent, recurved production outward and backward. On C 6, or possibly C 5, the process is of similar shape but is less produced, and on C 7 it is longer but less expanded, simpler, and directed downward and outward. The process on C ?7 of B is similar but relatively shorter and directed less ventrally. On C ?6 of B, however, the process is unlike anything preserved in A (but the latter is incompletely preserved), forming a great, hatchet-like ventral plate produced into a posterior horn, recalling the process on the sixth cervical of *Nesodon* although of different exact outline. All the centra are short, the width in each case considerably exceeding the length.

The anterior dorsals have the ordinary scale-like zygapophyses and present no marked peculiarities aside from the slenderness and small size of the spines (noted also in *Homalodotherium* by Scott), and their marked posterior inclination. There is no anticlinal vertebra, even the lumbar (and indeed the sacral) spines being slightly inclined posteriorly, an unusual character probably associated with relative inflexibility of the posterior dorsal and lumbar region. On the posterior dorsals the spine is very low, relatively lower than in *Homalodotherium*, barely rising above the prezygapophyses, but expanded anteroposteriorly, squarely truncated, and only slightly inclined backward. Its position is wholly posterior, between the postzygapophyses. The metapophyses so strongly developed in *Homalodotherium* are absent or perhaps barely indicated by a slight blunt process directed upward and outward from the prezygapophysis. On the most posterior dorsal known in *Homalodotherium* the cylindrical toxodont lumbar type of articulation is not indi-

<sup>1</sup> The probable seventh of A is here poorly preserved and the apparent canal may be anomalous or spurious.

cated on the pre- and barely suggested on the postzygapophyses but in *Thomashuxleya* this type is fully developed at a corresponding part of the series, the articulation being there at least as fully cylindrical as on any lumbar in *Nesodon*.

The lumbar articulations are more complex and rigidly interlocking than in Santa Cruz toxodonts (or typotheres) and remarkably parallel the very specialized condition in some artiodactyl lumbar (e. g., in *Odocoileus*). In addition to the cylindrical primary articulation, another lamina is developed above this so that the articular surface is strongly S-shaped in transverse section. A low, non-articular, antero-posterior crest on the dorsal surface of the prezygapophysis represents the still poorly developed metapophysis. Anapophyses appear to be lacking. The neural spines and centra are as in the posterior dorsals save that the latter are somewhat more elongate and the former tend (at least in A) to be bifid posteriorly. The transverse processes are long, simple, dorsoventrally compressed blades.

The sacrum, known only in A and there rather poorly preserved, seems to consist of four coalesced vertebrae of which three articulate with the ilium. The general outline seems to be very much as in *Adinotherium* save that in the latter (and most later notoungulates) several caudals still free in *Thomashuxleya* have become fused into the sacral complex. The first sacral has somewhat larger metapophyses than are preserved on any of the lumbar. Posterior to this the articulations appear only as blunt, but quite distinct, processes in which the elements are not distinguishable. The first two neural spines are separate and prominent and posterior to these is only a low, sharp, nearly undifferentiated ridge.

The anterior caudals (A and C) are large, heavy, dorsoventrally compressed bones with semicylindrical zygapophyses. The neural spines are merely sharp longitudinal ridges barely rising into free processes. The transverse processes are strong, broad plates. In C this stout structure is seen to break down rapidly, probably by about the seventh or eighth and almost surely before the tenth caudal, and the more distal vertebrae are short, irregular centra with no neural arches or zygapophyses. The inference is that the tail in these forms was heavy but short.

**RIBS.**—The ribs with the three specimens are not remarkable in any way. None are strongly expanded or more than slightly slab-like.

**STERNUM.**—Most of the sternum is preserved in B, and part of the presternum in A. The latter is like that of B, as far as preserved, except

for being larger and proportionately stouter. The presternum (of B) has prominent first rib articulations at the widest part of the bone, and between and anterior to them is a deep dorsal concavity or pocket. The ventral surface of this part of the bone has a very high median keel. The anterior dorsal border is not preserved. After narrowing posterior to the rib articulations, the bone expands slightly at the posterior end. It is here much wider than deep. This bone is very unlike that of *Homalodotherium*, and somewhat more but not at all exactly like *Nesodon*. In B there follow five (or possibly six) quadrate mesosternal segments, much compressed dorsoventrally, with projections at the four corners but otherwise almost featureless. It cannot be determined whether the last of these is the xiphisternum or how many other segments may have been present.

CLAVICLE.—What is indubitably a clavicle is present in B. It is a well developed but simple, slender, curved bone very unlike the element considered as a clavicle in *Homalodotherium*.

SCAPULA.—The scapula is peculiar, very unlike later toxodonts and somewhat more like some typotheres, e. g., *Protypotherium*. This part is too poorly known in *Homalodotherium* to make very useful comparisons. The spine is very high in A, with a flattened free border. There is a single prominent metacromion at the posteroinferior end of the spine in both A and B, but no second metacromion above this. The acromion is incomplete in both these specimens, but clearly was unusually large and stout, although not wide. In Amer. Mus. No. 28878, *Pleurostylodon*, the acromion is completely preserved and is smaller and directed less anteriorly than is indicated in A and B, being very like this part in *Protypotherium*. The prespinous surface in B is much larger than the postspinous and the coracoid process is a stout hooklike projection.

HUMERUS.—The proximal end, completely preserved only in B, has a large projecting greater tuberosity which is, however, much less prominent than in *Nesodon*, and a smaller but distinct lesser tuberosity. The deltoid crest is prominent in all three individuals, but is less so than in *Homalodotherium*, does not extend so far distally, and does not form a free projection at the distal end. The supinator crest is strong, relatively about as marked as in *Homalodotherium* and longer proximodistally. The entepicondyle is of moderate development in A and B, about as in *Homalodotherium*. In C it is relatively larger. The entepicondylar foramen, absent in *Homalodotherium*, is present in all three of these earlier forms.

RADIUS AND ULNA.—Radius and ulna are known in all three speci-

mens and are essentially similar in all three save that those of B and C are somewhat lighter in build as well as smaller and have the ulnar shaft and side of the olecranon more excavated. They are heavy, separate bones, more elongate than in *Nesodon* but less so than in *Homalodotherium*. The ulna is nearly straight, not as bowed as in *Homalodotherium*, although the strong olecranon is somewhat deflected to the internal side. The distal end (in A, poorly preserved in B and C) is slightly less transverse than in *Homalodotherium*. Other characters agree rather closely with the latter or with notoungulates in general. The radius is markedly arched, apparently more than in *Homalodotherium*. The proximal end is considerably more transverse than in the latter and less circular, probably indicating less power of rotation. The distal end is likewise somewhat more transverse than in *Homalodotherium* and the scaphoid articulation, which is partly concave, seems to be relatively slightly smaller in A and B, but perhaps not in C. The dorsal notch between the two surfaces is present but somewhat less pronounced than in the later genus.

MANUS.—The left carpus is perfectly preserved in B except for some breakage of the cuneiform. Most of the right carpals of A are represented, but all but the pisiform and trapezium are fragmentary, and there are a few elements from C, but the differences are important only for generic distinctions and need not be pointed out here. The following remarks are all based on B. The eight usual mammalian elements are all present and separate. On the dorsal or lateral exposures, the cuneiform, unciform, and pisiform are large, the lunar, scaphoid, and trapezium moderate, and the magnum and trapezoid small. In the carpus of *Homalodotherium*, the magnum, trapezoid, and to a slight degree the lunar are relatively larger while the scaphoid is relatively smaller. In the later genus the proximal elements are relatively shorter, especially noticeable in the lunar, while the known distal elements are all relatively longer. The earlier carpus is distinctly less serial. In *Homalodotherium* the only distal articulation for the scaphoid is with the trapezoid, but in B it also has distinct facets for trapezium and magnum. The lunar-magnum articulation is much larger than the lunar-unciform in the later genus, but they are of nearly equal size in B. The facets for metacarpal II on the magnum and for III on the unciform also appear to be relatively larger in the earlier form. The pisiform of B is quite as large as any other carpal, and has a large facet for the ulna, with which it must have been constantly in contact (whereas in *Homalodotherium* the ulna has no facet for the pisiform). There is a small radial sesamoid, proximal to the trapezium.

The metacarpals are rather short and stout, not elongate as in *Homalodotherium*. The descending order of length is III-II-IV-V-I. In the articulated carpus II and IV are of nearly equal length and the foot is mesaxonic, although not markedly so. Unlike *Homalodotherium* V is decidedly shorter and not stouter than II to IV. In B, I is nearly as long as V but more slender, and in A it is relatively much shorter, but in both it is well developed and fully functional. Its proximal articulation is far removed from that of II and it diverges very markedly from the other metacarpals, although its articulation does not permit it to be definitely opposed to them. Each metacarpal (except possibly I, in contact with which they are not preserved) has a pair of large distal palmar sesamoids. Between these the articular surface is keeled, but even here the keel is very slight and there is none on the globular purely distal and dorsal part of the articulation which normally was all that came in contact with the proximal phalange. The pose can only have been digitigrade, with the main weight falling on and immediately anterior to the row of sesamoids. The phalanges had much freedom of motion on the metacarpals and, apparently, independent of each other. The whole structure is one of an animal which has not lost or which is secondarily acquiring a grasping manus, very unlike any typical ungulate development.

The proximal and medial phalanges are short and stout, but less so than in *Homalodotherium*, and the medial phalanges are all distinctly shorter and smaller than the proximal. The articulation between these two is about as oblique as in the later form, and that for the unguals permits a nearly equal freedom of motion. The unguals are much less claw-like than in *Homalodotherium*, although they show a possible structural beginning of such a specialization. The more medial unguals are long, depressed, and deeply fissured. The more lateral are less depressed and have the fissure much smaller or possibly absent.

**PÆLVIS.**—Aside from a few scraps of no interest, the pelvis is known only in A, in which the posterior and inferior parts of the ischium and the inferior part of the pubis are missing. The whole pelvis is rather like that of *Homalodotherium*, especially the ilium which is similarly expanded into a great crescentic, nearly horizontal plate, but the obturator foramen is distinctly more oval and anteroposterior and the ischial spine is more definite and more posterior. As far as preserved the ischium and pubis are more toxodont- or even typothere-like than in *Homalodotherium*, or in other words more generalized within the Notoungulata.

**FEMUR.**—The femora (A and C but imperfect in both cases) are



much more primitive than in *Homalodotherium* and remarkably resemble those of *Hegetotherium* and *Protypotherium*, which may be assumed nearly to have retained the ancestral notoungulate structure in this part. The shaft is not notably flattened, the greater trochanter projects above the head, the notch between these is moderately pronounced. There is a lesser trochanter and it is prominent, the third trochanter is distinct, short proximodistally, and opposite or slightly distal to the lesser trochanter, and the patellar groove is relatively long and narrow—all features so fundamentally unlike *Homalodotherium* that, on this bone alone, the two types would hardly be supposed to be related at all.

**TIBIA AND FIBULA.**—The fibula is not known in A, B, or C, but is partly present in Amer. Mus. No. 28690, mentioned below, in which it is a slender, but complete and separate, bone of generally primitive character. The tibia, present in the specimen just mentioned and in C, is likewise primitive and altogether unlike that of *Homalodotherium*. It differs from the latter, among other ways, in being relatively longer and more slender, proximal and distal ends much less transverse, cnemial crest very prominent but less massive, extending farther distally, and ending more abruptly.

**PES.**—Of the pes, only the navicular and cuboid of C are preserved and surely identifiable in the three skeletons here chiefly considered. There is, however, another specimen, Amer. Mus. No. 28690, found by me at about the same level and locality as the three principal specimens, in which the tarsus, lacking only the distal end of the calcaneum, is well preserved and part of the metatarsus is present. The genus, or even family, is uncertain. The size is still smaller than C, but the morphology of the duplicated parts (including femur and tibia) is similar. The genus is probably not *Pleurostylodon*, but the family could well be the same (Isotemnidae) and in any event the tarsus is structurally primitive for the Notoungulata and probably also particularly for the Entelonychia. The following notes refer to this specimen.

The calcaneum is of normal proportions and the tuberosity is much less expanded than in *Homalodotherium*. The fibular facet is not preserved, but from the calcaneal facet on the fibula it must have been small. The trochlea of the astragalus is shallow and broad. There is a large astragalar foramen and a large, strongly differentiated groove for a flexor tendon. The neck is relatively long and the head spherical, somewhat transverse. There is no contact with the cuboid. The navicular is markedly transverse, although less so than in *Homalodotherium*, and the cuneiforms are all distinct, but the mesoeuneiform is very small.

The first metatarsal is shorter than the second but is functional and was followed by phalanges. The third metatarsal is markedly larger than the second. Both second and third are much more slender than in *Homalodotherium* and the distal articulations are nearly spherical on the dorsal side and sharply keeled on the plantar side. The cuboid articulations do not suggest enlargement of the fifth metatarsal.

When articulated with the tibia and fibula, this foot tends to incline somewhat toward the tibial border when the crus is vertical. The flexibility of the tarsus permits it to assume a normal position, whether plantigrade or digitigrade, but it seems very unlikely that the foot could be brought to rest on the fibular border as in *Homalodotherium* (in the opinion of Scott and of Ameghino). The exact posture cannot be determined, but it seems probable that the foot was semi-digitigrade. The posture indicated by the pes of *Homalodotherium* is probably one of its many secondary specializations.

**LIMB PROPORTIONS.**—A few indices for various limb elements indicate the rather generalized proportions of the Casamayor skeletons as compared with those of later notoungulates:

Index	Casamayor Specimens				<i>Homa-</i> <i>lodo-</i> <i>therium</i> <i>segoviae</i>	<i>Pro-</i> <i>typo-</i> <i>therium</i> <i>australe</i>	<i>Nesodon</i> <i>imbricatus</i>
	A	B	C	28690			
Radiohumeral	76	73	77	..	112	80	78
Metacarpohumeral	31	28	34	..	47	34	38
Humero femoral	85	..	95	..	76	94	97
Tibio femoral	..	..	88	..	60	113	87
Metatarsotibial	..	..	..	35	26	35	25

Some of these figures are approximate only, from various imperfections in the data, but they are adequate for broad comparisons. The figures for the Santa Cruz forms are calculated from measurements given by Scott and by Sinclair. More detailed consideration of proportions is deferred.

The Casamayor specimens agree rather closely with *Phenacodus*, save that the latter has the humerus slightly shorter relative to the three other elements with which these indices compare it, probably a reflection of the somewhat more cursorial habitus of *Phenacodus*. Even on this point the difference is not marked.

The Casamayor specimens differ little from the Santa Cruz typotheres and toxodont save for the cursorial lengthening of the tibia in the former and graviportal shortening of the metatarsus in the latter. *Homalodo-*

*therium* differs markedly in each of these indices. The strong inference is that the proportions of the Casamayor forms are approximately those primitive for notoungulates in general and that these proportions were little changed in Santa Cruz toxodonts and typotheres but that *Homalodotherium* is profoundly modified in limb proportions.

DISCUSSION.—It is not proposed to go into any detail at this time regarding the bearing of these skeletons on notoungulate morphology

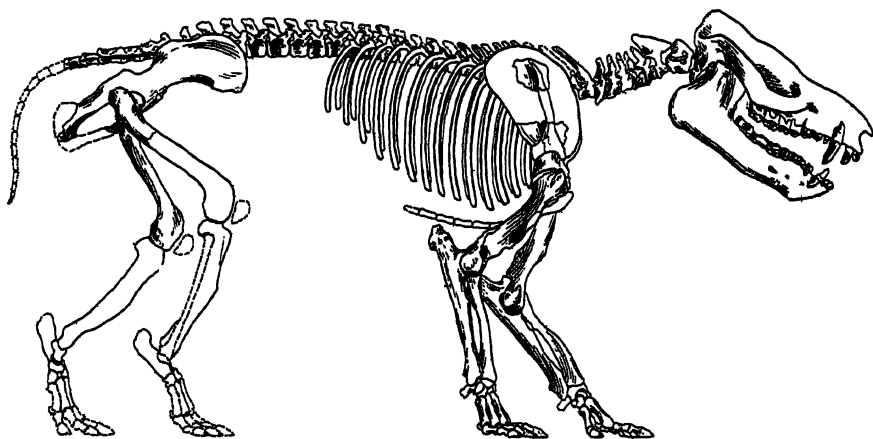


Fig. 1. *Thomashuxleya*. Reconstruction of skeleton. Skull and jaws are Amer. Mus. No. 28698, not associated with the skeleton but surely of the same genus and species, from the same horizon and locality, and of about the same individual age. Shaded parts of the skeleton are from Amer. Mus. No. 28905, a single individual. Unshaded parts in solid outline are from contemporaneous and closely related forms, scaled to the size of the individual skeleton. Parts in broken outline are restored from more distantly related notoungulates or in part hypothetical. (The ribs are shown in continuous outline, being in large part from a closely related form; they are partly present in this individual skeleton but it seemed unnecessary to indicate the exact outlines of fragments preserved). About one-twelfth natural size.

and phylogeny or to make many comparisons, but some broad conclusions stand out even in a brief review. *Thomashuxleya* is certainly a structural and possibly a direct ancestor of *Homalodotherium*. The several other Casamayor specimens examined are certainly no more specialized than *Thomashuxleya* and seem in some respects and to a slight degree to be less so. These facts together with the fairly complete series of dentitions, skulls, and jaws connecting *Thomashuxleya* with *Homalodotherium* suggest the hypothesis that the very marked difference in the



Fig. 2. *Thomasia huxleyi*. Restoration of living animal, based on the skeletal reconstruction (Fig. 1). The individual in the foreground is in exactly the same pose as the skeleton as figured, and is one-eleventh natural size. This is the largest animal known from the Casamayor, but is very primitive in most characters and nearly approaches the generalized ancestral notoungulate type.

limbs is caused by evolutionary advance and is not evidence that *Homalodotherium* is a descendant of an (unknown) more specialized Casamayor group.

If, as I believe, *Thomashuxleya* does represent a normal Casamayor entelonychian, it is striking that in structure it is on the whole such a generalized notoungulate, with only traces of incipient specialization recognizable as more particularly entelonychian. Among the possible inferences are:

1.—That *Homalodotherium*, despite its remarkable divergence in skeletal structure, was derived from the same general stock as the other notoungulates.

2.—That the entelonychian, or homalodotherine, group had not long been separated from the toxodont and typotheres stocks in Casamayor time.

3.—That the profound skeletal modification of *Homalodotherium* took place almost entirely in the span from Casamayor to Santa Cruz.

4.—That the Entelonychia are characterized by relative conservatism in dental structure and rapid skeletal evolution, whereas, on the whole, the reverse is true of typotheres and toxodonts.

NOTE ON *Periphragnis*.—*Periphragnis* Roth, 1899 (synonym, *Proasmodeus* Ameghino, 1902), from the Musters, represents the structural stage of homalodotherine evolution immediately following *Thomashuxleya*. There are two manus of *Periphragnis* collected by Roth in the Museo de la Plata which I have studied, thanks to the courtesy of the officials of that Museum, and which I propose to describe later. It is worth noting here that these manus show very little advance over that of *Thomashuxleya*, suggesting that at least in this part, and by inference probably throughout,<sup>1</sup> the profound modification of the homalodotheres is not only post-Casamayor but also post-Musters.

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<sup>1</sup> The skull and dentition of *Periphragnis* are also very close to *Thomashuxleya*.

# AMERICAN MUSEUM NOVITATES

Number 827

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

March 14, 1936

59.83, 4 S (69.1)

## THE MADAGASCAR HAMMERKOP DESCRIBED AS NEW

By A. L. RAND

In comparing the specimens of *Scopus umbretta* from Madagascar, collected by the Mission Zoologique Franco-Anglo-Américaine, with East African specimens it appears that the former differ enough to be separated subspecifically. For the Madagascar form I propose the following name.

### *Scopus umbretta tenuirostris*, new subspecies

TYPE.—No. 410683, American Museum Natural History; ♂ ad.; Tananarive, Madagascar; May 7, 1929; J. Delacour.

DIAGNOSIS.—Similar to *Scopus umbretta umbretta* but differs in having the bill considerably more slender (viewed from the side).

MEASUREMENTS.—The depth of the bill at the junction of the mandibular rami in the Madagascar birds is: ♂ 15, 16, 17; ♀ 15, sex? 17, 17; in the African specimens one male has the depth of the bill 17, but in twenty-two other males measured the depth varies from 17.7 to 20.9; in twenty-six females it varies from 17 to 20.8.

The Madagascar birds have the following measurements:

	MALE	FEMALE	SEX NOT DETERMINED
Wing	320, 322, 332	312	313, 315
Bill length <sup>1</sup>	74, 77, 78	75	71, 78
Tarsus	73, 74, 76	71	70, 71

These measurements fall within the range of measurements of the larger African form.

RANGE.—Madagascar.

REMARKS.—The above measurements show the difference between the slightly differentiated Madagascar race and the continental form. The measurement of the depth of the bill must be taken with care and specimens in which the mandible does not properly meet the maxilla discarded. I have considered all the larger African birds as *umbretta*, the only slightly larger size of *bannermani* making it doubtful whether it should be recognized (see Bates, 1931, Ibis, p. 302, and Chapin, 1932, Bull. Amer. Mus., LXV, p. 450). Specimens from South Africa have slightly more slender bills than those from East Africa, which are geographically nearest to the slender-billed Madagascar bird.

<sup>1</sup> Measured with dividers from the lateral feathering above nostril to tip.

Specimens of *umbretta* from Gaboon, which approach Madagascar birds in the depth of the bill, are somewhat smaller in other respects (wing ♂ 292, 305, ♀ 298, 300; bill length ♂ 72, 76, ♀ 70, 70), and are evidently an approach toward *minor*.

The smaller race, *minor*, from West Africa between Nigeria and Cameroon, has the depth of the bill as small as in Madagascar birds, but that is due to the smaller size of the bill (length of bill ♂ 67, 67, ♀ 62, 66, 68), not because it is more slender. The race *minor* may also be distinguished from the two other races by its smaller size and darker color (wing 250-266).

The six Madagascar specimens examined all have the barring on the tail very distinct. Some of the African specimens have the barring as distinct but in many of them the barring of the tail is somewhat obscure. There appears to be no constant plumage difference.







# AMERICAN MUSEUM NOVITATES

Number 828

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

March 16, 1936

59.82 (9)

## BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XXXI<sup>1</sup>

### DESCRIPTIONS OF TWENTY-FIVE SPECIES AND SUBSPECIES

By ERNST MAYR

The present paper contains the detailed descriptions of the new species and subspecies named in American Museum Novitates No 820.

#### *Haliaeetus sanfordi* Mayr

*Haliaeetus sanfordi* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 1.—Choiseul Island.

DIAGNOSIS.—ADULT.—Upper parts brown, upper back and lesser upper wing-coverts darker; hind-neck lighter and more rufous, lanceolate feathers with pale tips; head still lighter, forehead and superciliary pale ochraceous; chin, malar region, and uppermost throat also pale ochraceous; ear-coverts darker; throat and sides of neck rufous brown, feathers on upper throat with pale tips; breast, belly, thighs, and under tail-coverts dull rufous brown; under wing-coverts dark rufous brown; axillaries pale tawny; upper wing-coverts, scapulars, secondaries, and tertiaries dark brown (when fresh), pale brown (when old and faded); primaries blackish; entire tail black, tips of tail-feathers pale; in worn specimens the tail is dark brown and the pale tips worn off.

SUBADULT.—Wing and tail as in adult; all feathers of under parts and of upper back with droplike or triangular pale tips; innermost of lesser upper wing-coverts with narrow whitish edges.

IMMATURE.—Similar to adult, but wing-feathers narrower and more pointed; tail longer, tail-feathers also narrower, more pointed, and with pale tips; feathers of crown, nape, and back, and lesser wing-coverts with narrow or broad whitish tips; under wing-coverts and feathers of under parts also with buffy tips and sometimes with buffy shaft-streaks; general plumage coloration darker brown, less rufous; differs from *H. leucogaster* in the equivalent plumage by its entirely black tail, by the

	WING	TAIL-FEATHER	
		CENTRAL	OUTERMOST
♂ ad.	547, 525	259, (235)	207, 206
♀ ad.	575, 548, 535	283, 277, 245	236, 224, 205
	515, 560, 562	250, 269, 267	210, 218, 216
♂ juv.	563, 558	310, 296	248, 248
♀ juv.	535, 550	290, (265)	235, 250

Culmen, 43–45; tarsus, 91–102; middle-toe, 65–69; weight, 2300–2500 gr.

<sup>1</sup> Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, 337, 350, 356, 364, 365, 370, 419, 469, 486, 488, 489, 502, 504, 516, 520, 522, 531, 590, 609, 628, 651, 665, 666, 709, 714, and 820.

brown bases to the feathers of crown and nape; by the darker coloration of belly, thighs, and under tail-coverts, and by the rufous, not whitish coloration of the axillaries; base of inner webs of primaries not whitish, but grayish-rufous.

The measurements agree fairly well with those of *H. leucogaster*, although the wings average distinctly smaller. The wings were measured with a tape over the wing-bend and the central tail-feather with a rule; the outermost tail-feather could be measured with dividers, and its measurements are the most exact. Some of the specimens were apparently incorrectly sexed, there should be less overlap between the measurements of the two sexes. I recorded the measurements of a specimen in the British Museum (Ysabel Is., Brenchley coll., Sept. 1865) as wing 516, tail 231.

RANGE.—Solomon Islands (Choiseul, Arnavon, Ysabel, Vella Lavella, New Georgia, Kicha, Malaita, Guadalcanar, Ugi, and San Cristobal).

The discovery of this eagle will probably come as quite a surprise to most ornithologists. However, specimens of this species have been known for seventy years, but have always been identified as immatures of *H. leucogaster*. They were recorded as such by Gray (1870, Ann. Mag. Nat. Hist., (4) V, p. 328), by Ramsay (1882, Proc. Linn. Soc. New South Wales, VII, p. 29, 672), by Ogilvie Grant (1888, Proc. Zool. Soc. London, p. 188), and by Hartert (1929, Amer. Mus. Novit., No. 364, p. 1).

Soon after I had entered the Solomon Islands in 1929 with the Whitney South Sea Expedition I asked Dr. Hartert by letter about the name of the brown eagle which we found quite common on Choiseul Island. Dr. Hartert wrote me that there was no brown eagle known from the Solomon Islands and that I was probably referring to young specimens of *Haliaeetus leucogaster*. Knowing that young *H. leucogaster* looked quite different, I began to suspect that the Solomon Island bird was a new species, and the examination of a large amount of material after my return has only confirmed this belief.

I must have seen 15 or 20 eagles of this species during my stay in the Solomon Islands (among them many adults) and none of them showed any traces of white or whitish either on the under parts or on the tail. On Choiseul we found the bird commonly on Choiseul Bay along the coast and in the dense lowland forest, and also many miles inland on Mt. Maitambi at an altitude of more than 2000 feet, on San Cristobal, and on Malaita we found it only in the mountains (at about 4000 ft.).

*Haliaeetus leucogaster* (Gmelin) does not occur in the Solomon Islands and *H. sanfordi* seems to represent it there. This distribution

suggests, of course, the possibility that *sanfordi* might be a subspecies of *leucogaster*. There are several reasons which make me consider *sanfordi* a full species and not a subspecies: *Haliaeetus leucogaster* shows no variation of its coloration in its entire range from India to the Bismarck Archipelago and Australia; the coloration of *sanfordi* is quite different from that of the adult of any species of the genus *Haliaeetus*, and the habits, too, resemble more those of other eagles than those of sea-eagles. *H. sanfordi* seems to live more on phalangers and large birds (primarily pigeons) than on fish and carrion.

The structure of bill and feet and the feathering of the tarsus are practically the same as in *leucogaster*, and *sanfordi* must therefore be included in the genus *Haliaeetus* in spite of the difference in coloration. The genus *Haliaeetus* does not occur in Polynesia, notwithstanding several old reports in the literature.

#### *Gallicolumba sanctaecrucis* Mayr

*Gallicolumba sanctaecrucis* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 1.—Tinakula, Santa Cruz Islands.

ADULT MALE.—Chin and uppermost throat whitish; rest of throat and upper breast buffy vinaceous on a white basis; forehead, sides of head, and sides of neck light grayish; pileum and nape grayish brown, sometimes with a slight purplish gloss; back, scapulars, rump, and upper tail-coverts with a strong purplish-vioaceous gloss; this coloring is sometimes restricted to the edge of the feather, the center being more greenish; patch of feathers on the sides of the lower neck, and the lesser and median upper wing-coverts with a strong violaceous gloss; lower breast, belly, and under tail-coverts grayish brown; iris brown, bill black, feet red.

ADULT FEMALE.—Chin whitish with a light buffy tinge; forehead, sides of head, entire throat, upper breast tawny cinnamon; crown, nape, and sides of neck darker, rufous chestnut; back, rump, upper tail-coverts, scapulars, and upper wing-coverts glossy green, of variable color, sometimes more bronze-green, sometimes darker and more moss-green; central tail-feathers as the back, lateral tail-feathers rufous bronze with a black subterminal bar; under wing-coverts, lower breast, belly, and under tail-coverts pale grayish brown; iris brown, bill black, feet red.

MEASUREMENTS.—6 ♂ ad: wing, 138–145 (140.4); tail, 75–80; tarsus, 26–28; culmen, 14.0–15.5. 3 ♀: wing, molting; tail, 79; tarsus, 26; culmen, 14.0–15.0.

RANGE.—Tinakula and Utupua, Santa Cruz Archipelago.

All the five adult birds collected in March on Tinakula had enlarged gonads; of the four adult males collected on Utupua in September, two had the testes enlarged and two quiescent. All Tinakula birds are molting.

This new species is undoubtedly a geographical representative of *Gallicolumba stairii* of Central Polynesia. The geographical variation and nomenclature of the latter species are, however, still so little clear

and the distinguishing characters of *sanctaecrucis* so marked that it seems advisable to regard it a full species at the present time. *G. sanctaecrucis* differs from *stairii* by different proportions, much smaller size, absence of the chocolate color on neck and throat, and the smaller extent of the glossy patch on the wing bend.

*Gallicolumba sanctaecrucis* and *stairii* seem to belong to the *beccarii* group of the genus which is characterized by strong sexual dimorphism, a purplish patch on the bend of the wing, and the absence of white on the head. In the *jobiensis*-group male and female are similar (in most species!), the purplish gloss extends more or less all over the wing, and the head has white markings (superciliary, throat, etc.).

The distribution of the two groups in Polynesia is quite remarkable. The *beccarii*-group occurs in New Guinea, Admiralty Islands, Bismarck Archipelago, Solomon Islands, Rennell Island, Santa Cruz Islands, and central Polynesia (Fiji, Tonga, Samoa). The range of the *jobiensis*-group is very similar to that of the genus *Acrocephalus* (see 1933, Mitt. Zool. Mus. Berlin, XIX, Fig. 1). We have the following distribution: *jobiensis* (New Guinea and northern Melanesia), *canifrons* (Palau Is.), *xanthonura* (Marianne Is.), *yapensis* and *kubaryi* (Caroline Is.), *erythroptera* (Society and Tuamotu Islands) and *rubescens* (Marquesas). But no representative of this group occurs either in central Polynesia or in southern Melanesia.

#### *Gallicolumba jobiensis chalconota* Mayr

*Gallicolumba jobiensis chalconota* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 2.—Vella Lavella Island, British Solomon Islands.

SUBSPECIFIC CHARACTERS.—Similar to *Gallicolumba jobiensis jobiensis* Meyer, but white on lores reduced in width and not reaching the base of the nostrils; superciliary also much reduced in width and not reaching so far back on the sides of the head as in *jobiensis*; gray band from the base of the bill to the ear-coverts much wider; sides of the neck dark gray as the nape, not purplish in the lower portion; a band from one side of the breast to the other across the upper back glossy purplish (not as violet as in *jobiensis*); lesser upper wing-coverts glossy vinaceous purple; middle of back and upper tail-coverts glossy greenish bronze; tertials, greater and median upper wing-coverts, lower back, and rump (bronze-) green; white breast shield at least as large as in *jobiensis*; belly black, feathers with a slightly paler (grayish) margin; size apparently larger.

		WING	TARSUS	CULMEN (exposed)
<i>chalconota</i>	♂ ad.	147 + x	29.5	17
<i>jobiensis</i>	♂ ad.	145–149 (147.2)	27–28 (27.5)	15–16 (15.5)

RANGE.—Vella Lavella and Guadalcanar Islands, Solomon Islands.

The Whitney Expedition succeeded in getting only one specimen of the new subspecies during all the time it spent in the Solomon Islands, but it is fortunately an adult male in breeding condition, although with some of the wing-feathers molting. The species had already previously been recorded from Guadalcanar, Solomon Islands, although only immature specimens. (See 1893, 'Cat. Birds Brit. Mus.,' XXI, p. 599 (note).)

***Ceyx lepidus pallidus* Mayr**

*Ceyx lepidus pallidus* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 2.—Bougainville Island, Solomon Islands.

SUBSPECIFIC CHARACTERS.—Similar to *Ceyx lepidus meeki* Rothschild, but much paler underneath; breast and belly pale yellowish buff, instead of golden yellowish ochre; frontal spots and spots on the sides of the neck also decidedly paler than in *meeki*; no difference in regard to the coloration of the upper parts.

		WING	TAIL	BILL <sup>1</sup>
<i>pallidus</i>	2 ♂	57, 59	25, 26	29, 32
	1 ♀	59	21	25.5
<i>meeki</i>	2 ♂	57, 60	25	30, 31
	3 ♀	59, 60, 61	25, 26	26, 30, 31

RANGE.—Buka and Bougainville, Solomon Islands.

Even in the field the difference between the pale Bougainville and the richly colored birds from Choiseul was quite conspicuous.

***Ceyx lepidus malaitae* Mayr**

*Ceyx lepidus malaitae* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 2.—Malaita Island (3000 ft.), Solomon Islands.

SUBSPECIFIC CHARACTERS.—Similar to *Ceyx lepidus nigromaxilla*, but under parts much lighter, yellow-ochre, not deep ochraceous orange; loreal spot and spot on sides of neck equally lighter; upper parts also much lighter throughout; blue spots on head, neck, and upper wing-coverts not violet-ultramarine (R. X), but about phenyl-blue (R. IX); back, rump, and upper tail-coverts between methyl-blue and light methyl-blue, not deep purplish violet; maxilla blackish, mandible deep yellow, not reddish orange.

WING	TAIL	CULMEN	TARSUS	WEIGHT (gr.)
65	25	38	9	23

RANGE.—Malaita, Solomon Islands.

I pointed out already four years ago (Amer. Mus. Novit., No. 504, p. 15) that this form was probably new. I have compared the Malaita specimen in the meantime with another specimen of *nigromaxilla* in the British Museum and found all the differences confirmed.

<sup>1</sup> Measured from nostril to tip.

**Halcyon chloris mala** Mayr

*Halcyon chloris mala* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 2.—Malaita Island, British Solomon Is.

SUBSPECIFIC CHARACTERS.—Differs from *alberti* by smaller size, the much paler ochraceous coloration of the under parts and the collar, and the lighter, more greenish-, less blackish-blue coloration of the upper parts. Agrees with *tristrami* in the coloration of the upper parts, but differs from it by smaller size and the paler ochraceous under parts.

RANGE.—Malaita, Solomon Islands.

The measurements of the new subspecies and of the related races are as follows:

	WING	MALES	
		TAIL <sup>1</sup>	BILL <sup>2</sup>
Malaita (5)	98-105 (102.8)	61-67 (64.4)	35 -38 (36.5)
Central Sol. Is. (12)	105-112 (108.4)	67-72 (69.2)	40 -43 (41.1)
Guadalcanar (7)	107-111 (108.7)	68-71 (69.1)	36.5-40 (38.0)
Ysabel (7)	97-107 (102.0)	60-68 (64.0)	36 -38 (36.9)
Bougainville, etc. (6)	101-109 (106.8)	63-70 (66.8)	36 -40 (37.6)
Pavuvu (5)	106-110 (107.6)	65-70 (67.4)	39 -43 (41.3)
New Britain (6)	104-111 (106.7)	65-69 (67.8)	40 -43 (41.1)

	WING	FEMALES	
		TAIL <sup>1</sup>	BILL <sup>2</sup>
Malaita (7)	99-106 (104.2)	63-66 (64.5)	36-39 (37.9)
Central Sol. Is. (9)	107-113 (109.2)	68-73 (70.4)	39-45 (41.6)
Guadalcanar (6)	108-113 (109.0)	67-71 (68.9)	37-42 (39.8)
Ysabel (5)	103-108 (105.8)	65-71 (67.8)	36-41 (38.0)
Bougainville, etc. (5)	106-108 (107.0)	65-70 (67.6)	36-40 (38.0)
Pavuvu (5)	105-114 (109.5)	65-70 (67.8)	41-43 (41.6)
New Britain (6)	104-114 (109.3)	68-72 (70.2)	38-42 (40.2)

**Halcyon chloris pavuvu** Mayr

*Halcyon chloris pavuvu* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 2.—Pavuvu Island, Solomon Islands.

SUBSPECIFIC CHARACTERS.—Differs from *alberti* by the much paler (less ochraceous) under parts and by the much lighter (more greenish, less blackish) upper parts; the buffy loreal spots are enlarged and meet in some specimens in the middle of the forehead. Similar to *mala* in general coloration of the upper parts, but differing by larger size, larger loreal spots, and deeper ochraceous coloration of under parts.

RANGE.—Pavuvu Island, British Solomon Islands.

There is a certain variation of size and coloration within the range of *Halcyon chloris alberti*. The table of measurements shows that specimens from the type locality (central Solomon Islands) are largest,

<sup>1</sup> From the base to the tip of the longest tail-feather.

<sup>2</sup> From the nostril to the tip.

those from Ysabel smallest, while birds from the northern islands (Bougainville, Choiseul, etc.) are intermediate.

Guadalcanar birds differ from typical *alberti* (Kulambangra, etc.) by the more greenish, less blackish-blue coloration of the upper parts, by the admixture of greenish in the black of the loreal region and below the eye, and by the lighter blue of the wing. They show thus a slight approach toward *mala*, the differences are, however, too slight for the naming of a new subspecies.

Hartert (1926, Nov. Zool., XXXIII, p. 132) points out correctly that the birds from the Solomon Islands (*alberti*) are very similar to those from New Britain (*tristrami*). The under parts are particularly similar although specimens of *alberti* average distinctly more ochraceous rufous; *alberti* is usually very much darker on the upper parts, crown and nape often having a distinctly blackish tone; wings and tail are usually much deeper blue than in *tristrami*; a few specimens are hardly separable.

Males and females are quite different in all these subspecies, a fact which has not been sufficiently emphasized in the past. Only the males have the bright rufous under parts; females are much paler, the throat is whitish and the whitish middle belly contrasts with the ochraceous flanks.

#### *Ninox jacquinoti floridae* Mayr

*Ninox jacquinoti floridae* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 2.—Florida Island, Solomon Islands.

SUBSPECIFIC CHARACTERS.—Similar to *Ninox j. jacquinoti*, but much larger (see table of measurements); flanks darker, pattern of breast-band tending to continue downward along flanks.

RANGE.—Florida Island, British Solomon Islands.

When Hartert (1929, Amer. Mus. Novit., No. 364, p. 7) separated *N. j. eichhorni*, he included birds from Florida Island with typical *jacquinoti* from Ysabel. The following table of measurements shows

		WING	TAIL
Bougainville	5 ♂ ad.	190–195 (192.5)	89–99 (93.4)
	2 ♀ ad.	190, 191 (190.5)	96, 100 (98.5)
Choiseul <sup>1</sup>	3 ♂ ad.	186, 197, 201	99, 101, 103
	2 ♀ ad.	189, 195	95, 103
Ysabel <sup>2</sup>	5 ♂ ad.	195–201 (198.0)	96–105 (100.0)
	9 ♀ ad.	198–208 (202.3)	97–107 (100.6)
Florida <sup>3</sup>	2 ♂ ad.	218, 220	120, 120
	2 ♀ ad.	223, 223	118, 121

<sup>1</sup> Type locality of *eichhorni*; <sup>2</sup> type locality of *jacquinoti*; <sup>3</sup> type locality of *floridae*.



that this was not correct and that *eichhorni* is only a slightly differentiated form.

***Ninox jacquinoti* mono Mayr**

*Ninox jacquinoti* *mono* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 2.—Mono (Treasury Is.), Solomon Islands.

SUBSPECIFIC CHARACTERS.—Similar to *Ninox jacquinoti eichhorni* (Hartert), but spotting on upper parts finer, more rufous (less whitish), and more bandlike, less droplike; upper side of wing uniform brown with some sprinkling of rufous, not with distinct whitish bars on the upper wing-coverts and outer webs of secondaries and primaries, as in *eichhorni*; the white bars on the under side of the wing (inner webs) are also much less conspicuous or reduced to some whitish mottling; tarsus feathering brownish, not buffy as the abdomen.

	WING	TAIL
1 ♂ ad.	190	100
4 ♀ ad.	192–196 (193.0)	95–101 (99.5)

RANGE.—Mono or Treasury Island, Solomon Islands.

***Tyto alba interposita* Mayr**

*Tyto alba interposita* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 3.—Vanikoro, Santa Cruz Islands.

SUBSPECIFIC CHARACTERS.—Of small size; above and below conspicuously washed with buffy, tawny, or ochraceous colors; under parts variable, but never pure white; in the palest specimen there is only a light buff wash on the flanks, on the sides of breast and neck, and on the under wing-coverts; in the most richly colored bird, however (No. 219162), the entire under parts are pale ochraceous tawny, including the under wing-coverts, axillaries, and thigh-feathers; the feathers bordering the facial disk are brownish ochre, not whitish; the wing has a light gray pattern as in *lulu*, but not on whitish or buffy ground (with only a few ochraceous blotches) but on an orange-ochre underground; this ochraceous color shows particularly on the alula, the base of the primary-coverts, the median wing-coverts, and the outer webs of the primaries; it shows still more conspicuously on the tail, which is very pale grayish buffy in *lulu*.

	SEX	WING	TAIL
Vanikoro, Santa Cruz Islands	♂	273	110
" " " "	?	271	111
Vanua Lava, Banks Islands	♂	268	105
Epi, New Hebrides	♀	279	115

RANGE.—Santa Cruz Islands, Banks Islands, and northern New Hebrides.

The occurrence of a richly colored barn owl among all the white-bellied forms of the Australian Region is quite surprising. It shows considerable individual variation, but even the palest of the four specimens is quite different from any Polynesian specimen (*Tyto alba lulu*

(Peale)), of which I have seen 68 specimens. Aside from the buffy or ochraceous wash of the under parts there are the other above-mentioned characters which distinguish *interposita* immediately from any specimen of the neighboring races.

I am therefore at a loss to understand why Hartert (1929, Nov. Zool., XXXV, p. 100) failed to recognize the distinctness of the birds from the Santa Cruz Islands and New Hebrides. He mentions some of the peculiar color characters, but says: "That no importance can be attached to colour alone, unless its width of variation is known, is beautifully illustrated in two specimens from Vanikoro, one of which has the upper side much richer, and the under side a rich brownish ochre while that of the other specimen from the same locality is white with only a slight buffy tinge." However, even the paler of the two specimens is altogether different from any specimen of *lulu* with which Hartert unites it.

I have seen additional material of this form in other collections. The Rothschild collection contains one specimen of this form from the "New Hebrides" (wing 260, tail 109) with all the typical characters of this species, and in the British Museum I have seen two specimens, one from Malekula (Perry coll.) (wing 262, tail 104, tarsus 60) and one from Espiritu Santo (Farquhar coll.) (wing 279, tail 107, tarsus 61). The Malekula bird has a strong ochraceous wash on the under parts, while the Santo bird has only a faint buffy tinge.

Quite different from *interposita* of the northern New Hebrides is the barn owl of Aneiteum. It is an unusually pale bird. Of three specimens examined by me in the British Museum, one was without any black spots on the under parts, the second bird has a few spots, and the third is spotted as most specimens of *lulu*, to which race these birds are best referred.

Brasil (1916, Rev. Française d'Orn., IV, p. 202) separates the barn owl of Lifu, Loyalty Islands, from *lulu* as *lifuensis*, giving as only character the absence of black spots on the under parts. Hartert (1929, Nov. Zool., XXXV, p. 100) has already pointed out the invalidity of this character, but I may mention that there is in the British Museum a specimen from Lifu, Loyalty Islands (Whitmee coll.) (wing 272, tail 113) with some black spotting on the under parts. The specimen agrees well with other specimens of *lulu*, although the dark pattern on the wing appears coarser. *T. a. lifuensis* must be regarded a synonym of *lulu*.

New Caledonian specimens are apparently always spotted on the

under parts, they also average darker than most *lulu* on tail and upper parts, yet most specimens cannot be separated from a series of Polynesian birds.

**Tyto alba crassirostris** Mayr

*Tyto alba crassirostris* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 3.—Boang Island, Tanga group, Bismarck Archipelago.

SUBSPECIFIC CHARACTERS.—Similar to *T. a. delicatula* from Australia, but more robust, feet and bill stronger; height of maxilla in front of the cere 11.0–11.3 mm., against 8.5–9.4 mm. in *delicatula*. Spotting of the underparts and of the under wing coarser; black and white spots on back also larger; tawny-rufous colors in wing, tail, and back very much more pronounced; upper parts darker; bars on wing and tail broader and deeper in coloration; margin of facial disk darker and more conspicuous.

	WING	TAIL	HEIGHT OF MAXILLA
2 ♂ ad.	285, 290	113, 115	11.0, 11.3
3 ♀ ad.	286, 288, 290	115, 115, 116	11.0, 11.0, 11.2

RANGE.—Known only from the type locality.

The most remarkable feature of this series of barn owls is their great uniformity of coloration. The spotting on the under parts of the two males is somewhat finer than in the females, and one of the females has the upper parts rather more strongly washed with rufous ochraceous, but otherwise they are quite identical. This fact is quite important for the consideration of the barn owls of the Solomon Islands. Hartert (1929, Nov. Zool., XXXV, p. 100) records a specimen from Nissan and one from Vella Lavella as *delicatula*. The American Museum possesses now three additional specimens from the Solomon Islands and the conclusion to be drawn from these 5 specimens is, that every island has a population with its own peculiar characters. All of them agree that they have heavier bills than *delicatula* and I propose, therefore, to include these birds in *crassirostris* until more material is available. One Malaita bird is in coloration very similar to Boang birds, two Nissan birds are similar to *delicatula*, while one Vella Lavella and one Santa Anna specimen appear intermediate.

		WING	TAIL	HEIGHT OF MAXILLA
1 ♂	Nissan	288	113	10.1
1 ♀	"	281	113	10.7
1 ♂	Vella Lavella	279	115	10.6
1 ♀	Malaita	283	112	10.7
1 ♀	Santa Anna	273	109	9.6

*Collocalia (vanikorensis) pelewensis* Mayr

*Collocalia pelewensis* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 3.—Palau Island, Caroline Islands.

SUBSPECIFIC CHARACTERS.—Small; tarsus naked; upper parts dark fuscous green, with a brownish tone on the back; crown not very much darker than back; rump pale but no distinct light gray bar across the rump as in *spodiopygia*; there is much individual variation in the color of the rump, the bases of the feathers always being pale gray, the tips, however, sometimes being strongly glossy green, sometimes grayish; inner margins of the wing-feathers not particularly light; feathers of chin and throat soft and decomposed, with fuscous bases and rather sharply defined silvery gray edges, but no shaft-streaks; abdomen dull gray, slightly darker than throat, inconspicuous shaft-streaks on breast and abdomen, more pronounced ones on under tail-coverts; longest under tail-coverts fairly glossy green; white loreal spot inconspicuous.

Rather similar to *C. v. bartschi*, but differs by having a light rump, by having back and crown somewhat darker, by having the under parts decidedly lighter, and by having a different coloration of chin and throat; size and proportions also different; both agree in the pronounced development of the silvery basal rami of the feathers of back and belly.

Agrees with *Collocalia fuciphaga mearnsi* Oberholser in size and proportions, but differs by having a light colored rump, by having an apparently entirely naked tarsus, by not having the dark crown set off from the paler back as a dark cap, by the darker and duller coloration of the under parts, and by the reduced size of the white loreal spot.

RANGE.—Palau Islands.

The specific name of this new form is still quite doubtful. But this does not concern me greatly, since the same uncertainty is also true for practically all the other forms of the genus. The new form belongs undoubtedly in the relationship of *bartschi* from the Mariannes but it is very uncertain whether these two forms should be put near (*vanikorensis*) *inquieta* or *fuciphaga mearnsi*. As a matter of fact they represent in a way a connecting link.

	WING	TAIL-FEATHER	
		CENTRAL	OUTER
<i>pelewensis</i>	109.5-115 (112.9)	41.5-45 (43.2)	47-51.5 (49.1)
<i>bartschi</i>	105 -112 (109.1)	44 -47 (45.2)	50-53 (51.7)
<i>mearnsi</i>	108 -114.5 (112.1)	40.5-46 (43.6)	47-51.5 (49.0)
	TAIL-FURCATION	TAIL-WING INDEX	
<i>pelewensis</i>	4-7.5 (5.8)	43.5	
<i>bartschi</i>	5-8 (6.5)	47.4	
<i>mearnsi</i>	4-6.5 (5.4)	43.7	

***Collocalia vanikorensis ponapensis* Mayr**

*Collocalia vanikorensis ponapensis* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 3.—Ponape Island, Caroline Islands.

SUBSPECIFIC CHARACTERS.—Very similar to *inquieta*, but much smaller; on the upper parts apparently somewhat less glossy, and not so dark, more brownish; under parts very variable, sometimes very dark (partly on account of greasing), sometimes quite silvery on the throat; very dark specimens show some greenish gloss not only on the longest under tail-coverts, but also on the entire under side, except on the throat; rump of the same color as the back; tarsus unfeathered.

		WING	TAIL-FEATHER	
			CENTRAL	OUTER
<i>ponapensis</i>	15 ♂	106-113 (109.8)	41-45 (43.8)	49-54 (52.3)
	13 ♀	111-113 (111.6)	43-46 (44.7)	50-55 (52.0)
<i>inquieta</i>	11 ♂	117-121 (118.8)	44-48 (45.9)	53-58 (55.6)
	12 ♀	118-123 (119.9)	44-48 (46.7)	55-58 (56.5)
		TAIL-FURCATION	TAIL-WING INDEX	
<i>ponapensis</i>	15 ♂	7- 9 (8.4)	47.6	
	13 ♀	6- 9 (7.2)	46.6	
<i>inquieta</i>	11 ♂	8-11 (9.5)	46.8	
	12 ♀	9-11 (9.7)	47.1	

RANGE.—Ponape, Caroline Islands.

Kuroda described very inadequately in 1915 a *Collocalia* from Ruk Island. His measurements (wing 112-119.5, tail 54-56) indicate that the Ruk Island bird is intermediate in size but nearer to *inquieta*. Kuroda compared his specimens with so-called "*fuciphaga vanikorensis*," apparently ignorant of the existence of *inquieta*. He also lets two subspecies of *fuciphaga* occur on the same island, apparently not quite realizing the geographical use of the term subspecies.

Many of the specimens collected by Coultas (in November and December) are molting.

***Collocalia lowi orientalis* Mayr**

*Collocalia lowi orientalis* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 3.—Guadalcanar, Solomon Islands.

SUBSPECIFIC CHARACTERS.—Similar to *Collocalia lowi whiteheadi*, but upper parts much darker; crown and back with a dark bluish-green gloss; rump not of the same color as the back, but much lighter, light grayish, and with the gloss much reduced; under wing-coverts along the bend of the wing with broad pale margins; feathers of chin and throat with dark shaft-streaks and whitish margins; throat decidedly lighter than dark-colored belly; white loreal spot very inconspicuous; sides of head darker; bill very strong, but not as long as in *whiteheadi*; tarsus with a few feathers.

	WING	SHORTEST TAIL-FEATHER
1 ♂	(132)	(49)

RANGE.—Guadalcanar, Solomon Islands.

This bird is so different from the other subspecies of *lowi*, that I feel confident in describing it, although I have only one specimen. Unfortunately the bird is molting and the correct length of the tail cannot be determined.

The species is also known from a single specimen collected on Mt. Goliath, Snow Mts., by Meek, which seems to be very similar to *whiteheadi* from the Philippines, but is slightly larger, has the upper parts darker and more bluish and the light-colored throat set off more sharply against the darker belly.

#### *Pitta anerythra nigrifrons* Mayr

*Pitta anerythra nigrifrons* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 4—Tauro, Choiseul Island, Solomon Islands.

SUBSPECIFIC CHARACTERS.—Similar to *Pitta anerythra anerythra* Rothschild, but with much more black in the plumage; forehead, in some specimens the entire upper crown, and even the bases of the feathers of the nape, black; in *anerythra* only a narrow line across the forehead is black and the bases of the feathers of the nape are grayish; the black on the sides of the head and on the chin also more extensive; white bar across the fourth to seventh primary apparently also reduced; coloration of under parts similar, not pale as in *pallida* from Bougainville.

MEASUREMENTS.—Wing, 96–101 (98.9); tail, 35–38 (36.5); tarsus, 41–43 (42); in *anerythra* the wing measures, 100, 102; the tail, 37, 38; and the tarsus, 43, 44; *pallida* is somewhat larger: wing, 99–108; tail, 38–41; tarsus, 43–46.

RANGE.—Choiseul, Solomon Islands.

MATERIAL.—Bougainville (*pallida*): 2 ♂, 3 ♀; Choiseul (*nigrifrons*) 6 ♂, 3 ♀; Ysabel (*anerythra*) 2 ♂, including the type.

The development of the black in the Choiseul specimens shows a distinct tendency toward the black-headed *pallida*, while *nigrifrons* is quite like *anerythra* in size and coloration of under parts. There is a good deal of individual variation in *nigrifrons*. In some specimens almost the entire crown is blackish, while in others it is restricted to a patch on the forehead. The black bases on the feathers of crown and nape are also varying in extent. None of the Choiseul birds can, however, be confused with the two typical Ysabel specimens.

#### *Coracina lineata makirae* Mayr

*Coracina lineata makirae* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 4.—San Cristobal (Makira), Solomon Islands.

SUBSPECIFIC CHARACTERS.—Male, similar to that of *Coracina lineata malaitae*

Mayr, but slightly larger and heavier; under parts not nearly uniform gray with an indication of whitish bars, but with distinct narrow white bars on breast and upper belly, and with black and broader white bars on the gray of lower belly and under tail-coverts; female, very similar to that of *malaitae*, but with the black bars on the abdomen apparently more, and the white bars less, pronounced; there is, however, a great deal of individual variation.

	WING	TAIL	WEIGHT (gr.)
3 ♂ ad.	140, 141, 141	109, 110, 112	75, 79, 79
1 ♂ imm.	137	....	.....
6 ♀ ad.	133-143 (137.7)	105-111	66, 74, 82

RANGE.—San Cristobal Island, Solomon Islands.

This form is interesting since it shows a certain approach toward *gracilis* (Rennel) and *lineata* (Australia) by the reduction of the sexual dimorphism.

This species was missed on San Cristobal by Meek, but had been previously reported by Ramsay under the name *sublineatus* (Proc. Linn. Soc. New South Wales, VII, p. 22) and apparently also by Tristram (1879, Ibis, p. 441).

#### *Turdus margaretae* Mayr

*Turdus margaretae* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 4.—San Cristobal, Solomon Islands (1900 ft.)

ADULT.—Upper parts uniformly colored, olivaceous brown, darker and duller on the head, warmer and more rufous on lower back and rump; scapulars of the same color as back; although the back seems to have a uniform color, most feathers show an indication of a dark terminal or subterminal band; feathers of lores, superciliary, and cheeks with white bases and blackish tips; sides of head brownish, feathers with whitish shaft-streaks; breast olivaceous gray, every feather with broad gray base, with a subterminal triangular white spot or band, and a broad olivaceous brown or blackish edge; sides of breast and flanks similar, but triangular white spots larger and more longitudinal; middle of belly, thighs, and under tail-coverts white; wing dark brown, outer webs of primaries and secondaries warmer brown (burnt umber); tertials with small white or buff subterminal spots; upper wing-coverts blackish brown with round white subterminal spots; primary-coverts uniform brownish; lesser set of under wing-coverts whitish, median set black, greater set grayish as underside of wing; white band across underside of wing from the fifth primary to the innermost secondary; tail uniform brown without white marks on the outermost tail-feathers.

IMMATURE.—Similar to adult, but upper parts with a somewhat scaly appearance; black terminal, and russet subterminal bars are indicated on the feathers of the back; on forehead and nape the feathers tend to have light centers; underparts as in adult, but white spots in centers of feathers with an ochraceous wash along the black margin; feathers on throat, crissum, and rump softer; tail-feathers more pointed.

"Iris brown ("blue" in young birds), bill black, feet pinkish white."

	WING	TAIL	TARSUS	CULMEN	WEIGHT (gr.)
♂ ad.	95 + x	71	36	26	71
♀ ad.	91, 95	66, 66	34, 34.5	24, 25	60, 72
♂ imm.	99	73	37.5	26	70
♀ imm.	92	67	37	25	61

CULMEN (exposed), 20-21; hind-toe (with claw), 20 mm.

RANGE.—San Cristobal, Solomon Islands.

Not uncommon at 1800-2000 feet near the village of Hunogarah, but very secretive. All the specimens were collected by the natives.

There is some individual variation in these birds; one of the adult females has the white parts of the underside pure white, the other has them strongly washed with tawny ochraceous, particularly on the under tail-coverts, while the single adult male is intermediate, having a slight wash only.

This species is in a way a representative of the *Geocichla dauma*-group, which ranges with *choiseuli* Hartert as far as the Solomon Islands. It differs, however, from *dauma* in so many characters that it must be regarded as a separate species. Particularly significant in this connection are, in *Turdus margaretae*, the uniformly colored upper parts, the different pattern of coloration on under parts and on the wing, the pure white subterminal spots of the upper wing-coverts, the lack of whitish on the outer tail-feathers, and the different proportions.

In some of its structures and proportions *Turdus margaretae* shows an approach toward the genus *Amalocichla*, which, however, has a still rounder wing and much longer tarsus. In *T. margaretae* the wing-formula is:  $5 > 4 > (\text{or} = \text{or} <) 6 > 3 > 7 > 8 > 2 > (\text{or} = \text{or} <) 9 > 10$ . The wing tip is very short, the longest primary only 11-13 mm. longer than the secondaries. The first primary, which in most other *Turdus* is shorter than the primary-coverts or equally long, is in *margaretae* 9-15 (12.0) mm. longer. This, however, is also the case in some subspecies of *Turdus dauma*.

#### *Vitia parens* Mayr

*Vitia parens* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 4.—San Cristobal, Solomon Islands.

ADULT.—General coloration brownish; forehead and fore-parts of crown ochraceous brown; hind-neck, scapulars, back, and rump a dull grayish olivaceous brown (chucker brown); tail brownish; chin, upper throat, and sides of head pale ochraceous; breast, flanks, belly, and under tail-coverts brownish gray; wing brown, edges of outer primaries paler, more cinnamon brown; female like male, but somewhat duller and darker particularly on forehead and upper throat.

NESTLING.—Quite different from adult; middle of throat yellowish; breast,



belly, and flanks grayish olivaceous, lower belly and under tail-coverts with a brownish wash; forehead and crown fuscous; back, wings, and tail fuscous brown; under wing-coverts yellowish; the whole plumage very soft.

	WING	TAIL	TARSUS	CULMEN	WEIGHT (gr.)
3 ♂ ad.	60-61 (60.8)	50, 50	25-26	17.8-19.0	18.5-19
2 ♀ ad.	52.5, 55	43, 45	23, 24.5	17.6, 18.3	14, 14
1 ♂ juv.	53	40 + x	25	16	17

RANGE.—Mountains of San Cristobal, Solomon Islands (Dec. 7-14, 1929).

This is the first record of the genus outside of Polynesia. *V. parens* resembles *Sericornis nouhuysi* in coloration a great deal and when collected was believed by me to belong to the genus *Sericornis*. The following table of characters shows, however, clearly that it is congeneric with *Vitia ruficapilla*. It agrees with it in bill and tail, but differs from it sufficiently in general coloration, proportions, and shape of the wing to be considered a separate species.

	<i>V. ruficapilla</i>	<i>V. parens</i>	<i>Sericornis</i> .
Bill	Long and slender, straight	Medium and slender, a little broader at base	Shorter and thicker, fairly broad at base
Mandible	Gonys flat	Gonys keeled	
Rictal bristles	Weak and short	Weak and short	Weak and short
Tarsus/Culmen	24/18.5-19	25-25.5/18	22/16
Tail	Long and weak, graduated	Long and weak, graduated	Short and strong, square
Wing and wing-feathers	More rounded 1st primary long	Less rounded 1st primary shorter	Pointed

This is a mountain species on San Cristobal; the 6 specimens of the collection were obtained near the village Hunogarahā at 1900 feet and above. The presence of one nestling and the heavy molt of all the other specimens points to the conclusion that in December the breeding season has probably just ended.

#### *Vitia ruficapilla castaneoptera* Mayr

*Vitia ruficapilla castaneoptera* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 5.—Vanua Levu, Fiji Islands.

SUBSPECIFIC CHARACTERS.—Similar to *badiceps* (Finsch) from Viti Levu, but more brownish throughout; lores, cheeks, ear-coverts, and sides of face grayish buff, not gray; dark line across eye not pronounced; crown slightly darker and duller; back and rump more brownish; wings and tail brown, not fuscous; under tail-coverts brown, not olivaceous gray; differs from *ruficapilla* in the dark crown and the brown wings and tail; size fairly large.

	WING	TAIL
13 ♂	56-62 (59.2)	55-62 (58.7)
6 ♀	52-55 (54.0)	49-56 (52.7)

RANGE.—Vanua Levu, Fiji Islands.

*Vitia ruficapilla funebris* Mayr

*Vitia ruficapilla funebris* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 5.—Taviuni, Fiji Islands.

SUBSPECIFIC CHARACTERS.—Similar to *Vitia ruficapilla badiceps* (Finsch), but darker and duller; back and rump a sooty brownish gray; wings fuscous, feathers with dark gray edges; tail blackish; sides of head grayish ochre; lores and superciliary buffy; black loreal and postocular streak well visible; crown still darker than in *castaneoptera*, on nape almost sepia; lower belly and under tail-coverts brownish; very large.

	WING	TAIL
10 ♂ ad.	59-65 (61.8)	54-60 (57.5)
3 ♀ ad.	54-56 (55.0)	49-50 (49.5)

RANGE.—Taviuni Island, Fiji Islands.

*Phylloscopus trivirgatus bougainvillei* Mayr

*Phylloscopus trivirgatus bougainvillei* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 5.—Bougainville Island, Solomon Islands.

SUBSPECIFIC CHARACTERS.—Similar to *P. t. becki* Hartert but paler, less yellowish underneath; under parts more suffused with grayish, flanks therefore appearing more olivaceous; upper parts slightly darker, crown less greenish, more blackish, thus contrasting more with the back; sides of face dark, superciliary still less conspicuous; light olivaceous stripe along center of crown barely indicated; white tips on lateral tail-feathers reduced or absent, white edges on inner webs of wing-feathers narrower.

	WING	TAIL
12 ♂ ad.	56-60 (58.1)	40-45 (42.4)
3 ♀ ad.	52, 53.5, 55.5	38, 40

RANGE.—Mountains of Bougainville Island, Solomon Islands.

This form is less yellowish underneath than most forms of *trivirgatus*; it resembles in this respect *presbytis* from Timor, from which it differs, however, in many other respects.

*Phylloscopus trivirgatus pallescens* Mayr

*Phylloscopus trivirgatus pallescens* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 5.—Kulambangra, Solomon Islands.

SUBSPECIFIC CHARACTERS.—Similar to *becki*, but under parts almost whitish, just with a faint tinge of yellowish; upper parts as in *becki*, but crown darker, less greenish; white superciliary well developed; no white in tail; differs from *bougain-*

*villiei* in the reduction of yellow on the under parts, the less blackish crown, and the more conspicuous superciliary.

Wing, 56; tail, 39.

RANGE.—Kulambangra Island, Solomon Islands.

Although the Whitney Expedition obtained only one specimen, the Kulambangra bird differs by its whitish belly so markedly from all the other *Phylloscopus* of the Papuan region that I do not hesitate to describe it.

### *Phylloscopus trivirgatus makirensis* Mayr

*Phylloscopus trivirgatus makirensis* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 5.—San Cristobal Island, Solomon Islands.

SUBSPECIFIC CHARACTERS.—Very similar to *poliocephalus*, but back more citrine, less greenish; crown less grayish, more fuscous olivaceous, sometimes with an indication of a citrine central stripe; white superciliary not as pronounced; sides of head more mottled, less whitish; upper throat white, rest of under parts yellow, even richer than in *poliocephalus*; outermost tail-feathers with broad yellowish-white edges on inner web; inner webs of wing-feathers with broad yellowish-white, not narrow white, margins; differs from *becki* by the rich yellow of the belly, the citrine of the back, and the much smaller size.

	WING	TAIL	WEIGHT (gr.)
6 ♂ ad.	52–55 (53.2)	38–40 (38.6)	8–10 (9.1)
5 ♀ ad.	49–51 (50.0)	35–37 (36.3)	8–9 (8.5)
Tarsus, 20; culmen, 30.			

RANGE.—San Cristobal, Solomon Islands.

We found this warbler fairly common near Hunogarahra (1900 ft.). It occurred anywhere above 1000 or 1200 feet, mainly in second growth formation and on the edge of the forest. It is remarkable that the bird had exactly the same song as *Ph. triv. poliocephalus* and *giulianettii* in New Guinea.

### *Monarcha castaneiventris obscurior* Mayr

*Monarcha castaneiventris obscurior* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 5.—Pavuvu Island, Solomon Islands.

SUBSPECIFIC CHARACTERS.—Similar to *Monarcha cast. castaneiventris*, but darker throughout; bluish gloss on upper parts and throat stronger, almost metallic; abdomen darker chestnut; bluish black of throat extending farther down on breast and flanks; axillaries mostly black, not more or less chestnut as in *castaneiventris*; thighs completely black; slightly smaller (adult males from Guadalcanar have a wing of 83–86 (85.0), and a tail of 68–72 (70.3)).

	WING	TAIL
16 ♂ ad.	81–86 (83.0)	65–70 (67.4)
4 ♀ ad.	79–81 (80.0)	66–67 (66.2)

RANGE.—Pavuvu Islands (Pavuvu, Banika, Moie, and Kiomie), Solomon Islands.

Interesting is a melanistic specimen (No. 225863) which is completely black, except for some brown-tipped feathers in the middle of the belly. The bird shows thus a tendency toward *Monarcha castaneiventris ugiensis*, which is completely black.

***Monarcha barbata ganongae* Mayr**

*Monarcha barbata ganongae* MAYR, 1935, Amer. Mus. Novit., No. 820, p. 6.—Ganonga Island, Solomon Islands.

SUBSPECIFIC CHARACTERS.—Intermediate between *nigrotecta* from Vella Lavella, and *browni* from Kulambangra, agreeing in the coloration of the throat with the former, in the coloration of the wing with the latter; the black throat patch is small as in *nigrotecta*, not connected with a black area on the sides of the breast; wing not entirely black as in *nigrotecta*, but greater and tips of median upper wing-coverts white; extent of white on tail also intermediate, the tips of the second innermost tail-feather black, but white on the tips of the four outer pairs more extended than in *browni*.

GANONGA	WING	TAIL
4 ♂ ad.	83-87 (85.0)	73-77 (74.5)
3 ♀ ad.	80, 81, 81	75
VELLA LAVELLA		
6 ♂ ad.	81-85 (83.3)	71-79 (74.5)
4 ♀ ad.	80-83 (81.4)	73, 75
BAGGA		
6 ♂ ad.	86-88 (86.8)	76-79 (77.8)
1 ♀ ad.	80	74

RANGE.—Ganonga, Solomon Islands.

It is interesting that the three neighboring islands, Vella Lavella, Ganonga, and Kulambangra, have such distinct forms. The birds from Bagga Island agree in coloration perfectly with Vella Lavella specimens and might best be referred to *nigrotecta*, although they are somewhat larger than Vella Lavella specimens.



## TWISTED CRYSTALS OF PYRITE AND SMOKY QUARTZ

BY CLIFFORD FRONDEL

Twisted crystals are so rare in nature that any information regarding new occurrences is worthy of record. General accounts of the phenomenon of twisting in crystals have been given by Spencer (1921), Bernauer (1929), and Rossmann (1934).



Fig. 1. Pyrite crystal twisted on the trigonal axes of symmetry. Natural size.

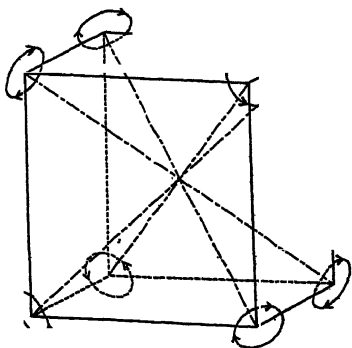


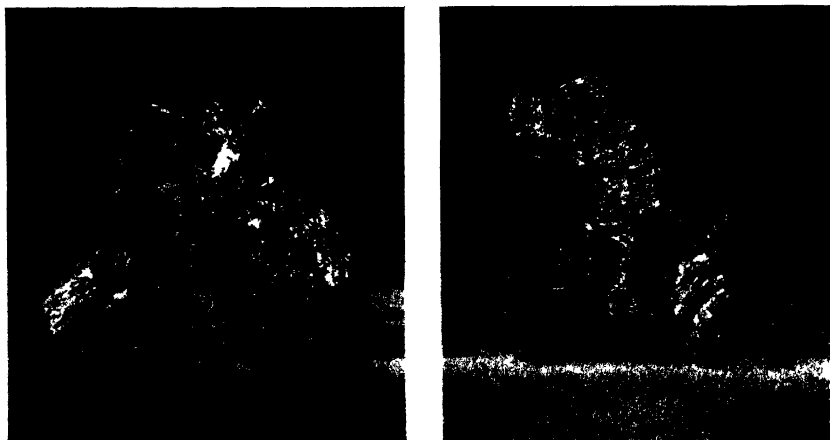
Fig. 2. Diagram illustrating the sense of the twist in the trigonal axes.

## PYRITE, FRENCH CREEK, CHESTER COUNTY, PENNSYLVANIA

Axially twisted pyrite crystals have not heretofore been described, although bent crystals and crystals with concave or convex faces are known. The present instance is afforded by a suite of 16 specimens from French Creek, Chester County, Pennsylvania, which exhibit twisted and twisted skeletonized cubes of pyrite implanted on drusy crystals of magnetite and specularite. The pyrite crystals on a few of the specimens are partly covered by deeply etched crystals of calcite that are colored green by included fibers of byssolite.

A typical twisted cube is shown in Fig. 1. The axes of torsion are the trigonal (octahedral) axes of symmetry. The twist in these axes is such that the opposite corners of each trigonal axis are twisted in the same sense, with the two trigonal axes in each vertical diagonal plane of symmetry each twisted in an opposite sense. This relation is sketched in Fig. 2.

An extreme instance of such twisting is shown in Figs. 3*a*–3*b*. This crystal is a skeletonized and markedly composite cube with the corners twisted, in the manner described, through approximately 60°. The larger individuals forming the twisted, composite crystal are composed of



Figs. 3*a*–3*b*. Two views of a skeletonized and twisted pyrite cube. The upper right corner of the cube face represented in Fig. 3*b* has been broken off. Natural size.

much smaller crystals closely aggregated in nearly parallel position. The largest of the sub-individuals are those occupying the corner positions.

Several small pyrite crystals in the suite are not twisted, but exhibit a peculiar composite structure in which eight separate cubes are grouped together to form a single large cube. The several parts are not quite parallel, but diverge at small angles and may be separated, in part, by open cracks. One of these crystals, in which the four crystals forming the base of the larger, composite cube are subordinate in size and do not appear in the photograph, is shown in Fig. 4. The composite structure

in these crystals, and in the preceding, twisted crystals, appears to be the result of lineage growth, as described by Buerger (1934).

Cobalt and arsenic were found by Genth (1875) as impurities in the pyrite from French Creek, and the twisting and composite growth of



Fig. 4. Composite cube formed of eight separate cubes in approximately parallel position. Only the upper four of the small cubes can be seen in the photograph. Natural size.

Fig. 5. A pale smoky quartz crystal twisted on a lateral, digonal axis. The crystal is distorted by elongation and flattening parallel to this axis. The horizontal face at the top of the crystal is a prism face—the crystal is oriented with the twisted  $a$ -axis vertical—and the small triangular face immediately below it belongs to the trapezohedron (5161). The unusual habit gives the crystal an orthorhombic aspect. St. Gotthard, Switzerland. Natural size.



the crystals is possibly caused by the presence of these elements in solid solution. The dissimilarity of properties—size, polarizability, deformability, etc.—of the foreign atoms and the Fe and S atoms would distort the crystal lattice, and the lattice strain set up in this way would very



likely cause abnormalities in the growth of the crystal. If this is the case, the directional nature of the distortion suggests that the foreign atoms are arranged along certain planes only.

The locality at French Creek has also yielded pyrite crystals that are remarkable in being tetragonal or orthorhombic in outward symmetry, the crystals appearing as curved vicinal pyramids elongated in the direction of one crystallographic axis. These crystals have been described by Penfield (1889), in part from specimens originally contained in the Bement collection and now in the collection of the American Museum.



Fig. 6. A dark smoky quartz crystal twisted on the vertical trigonal axis. El Paso County, Colorado. One-half natural size.

## SMOKY QUARTZ, EL PASO COUNTY, COLORADO

Twisted smoky quartz crystals from several European localities have been described. Two types of twisting have been found: the axis of torsion being either a lateral, digonal axis, or the vertical, trigonal axis. A crystal of the former type, from St. Gotthard, Switzerland, is shown in Fig. 5. Similar instances from other localities in Switzerland have been described by Tschermak (1894), Rosický (1933), and others.

A smoky quartz crystal twisted on the vertical, trigonal axis, from El Paso County, Colorado, is shown in Fig. 6. The crystal is distorted by flattening parallel to a pair of prism faces and measures  $21 \times 2.9 \times 1.7$  cm. It is a right-handed individual, twinned on (10 $\bar{1}$ 0), with corroded faces of the positive and negative unit rhombohedrons, an unidentified steep rhombohedron, and the right positive trapezohedron (51 $\bar{1}$ 1). The twist is right-handed and is approximately  $45^\circ$  in 21 cm. of length.

The occurrence of twisting in the smoky variety of quartz and its general absence in the colorless and amethystine varieties suggests a connection with the pigmentation of the crystals, as was found experimentally by Bernauer and others for twisted crystals of various substances grown from solutions containing organic impurities. This would oppose Holden's contention that the pigment of smoky quartz is of a secondary origin, produced in an originally colorless crystal by the action of radiation. The writer (1934) has described further evidence that indicates a primary origin of the color of smoky quartz.

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59.51, 8 (74.9)

PSAMMOLITTORAL ROTIFERS OF LENAPE AND UNION  
LAKES, NEW JERSEY

BY FRANK J. MYERS

The present work is the result of a study pursued during the spring, summer and fall of 1934, on the rotatorian fauna that inhabits the moist sand zones, adjacent to and above the level, of various bodies of water situated in the pine-barren area of southern New Jersey, especially Lenape and Union Lakes, in Atlantic and Cumberland Counties, respectively.

The soil of this area consists of gravel and sand beds which were at one time the bottom of the ocean. As a result of ages of weathering, most of the calcium and potassium salts as well as the calcium carbonate have been leached out. Acids arising from vegetable decomposition and other sources remain unneutralized, therefore the waters are acid.

There are no natural lakes in this portion of the state. The so-called "lakes" are merely dammed areas which, at present or formerly, served for power purposes.

On account of their relatively larger size, the majority of collections were made along the shores of the above two "lakes." Lenape Lake is formed by a dam and is about two miles in length and about one-third of a mile in width at the widest part. It is thirteen feet above sea level, and the  $p_H$  varies between 5.0 and 6.4. Union Lake is about three miles long and about one-half of a mile wide at the widest part. It is twenty-six feet above sea level, and the  $p_H$  varies between 6.0 and 6.8.

The water of both lakes is colored a dark reddish brown, due to infusions of decaying plant material, as a result of draining large areas of sphagnum bogs. The inlets and adjacent banks are marshy, due to plant encroachment, and contain no exposed sand zones. Nearer the middle and the outlets there are many low zones of exposed sand. It was in such locations that most of the collections were made.

Samples of moist sand were taken at different distances from the water level, in the regions of the "hydropsammon,"<sup>1</sup> the "hydrops-

<sup>1</sup> Wiszniewski has proposed a nomenclature based on the ecology of the psammolittoral. Among the important terms are: "hydropsammon," submerged sand along the shore of a body of water; "hygropsammon," sand above and adjacent to the water level that is completely saturated by capillary attraction and wave action; "eupsammon," outer boundary of the hygropsammon, partially saturated, and submerged only during periods of high water.

ammon" and the "eupsammon." To these were added a certain quantity of filtered water from the main source. Later, the various containers were shaken as needed, the superincumbent water quickly decanted and then examined under a binocular microscope.

Most of the samples were from the hygropsammon, which is composed of two phases: "the sand grains, having no value as far as conditions of existence to rotifer life are concerned, and the water contained between them." It is there the optimum conditions of food, oxygen and light prevail: it is there the sand is fully saturated with water, due to wave action and also by being drawn up by capillary attraction to replace that lost by evaporation, thus making conditions of existence ideal for psammobiotic rotifers.

Wiszniewski recently studied the rotifers living in the psammolittoral along the banks of Lake Wigry, Poland, and other bodies of water in that country. The  $p_H$  was uniformly 7.5. The results were so rich that the author was able to compile a list of 82 species occurring in the moist sand.<sup>1</sup> No such habitat had previously been searched with careful scrutiny for rotifers.

In order to compare the psammolittoral rotifers, found in the alkaline waters of Poland, with those from the acid bodies of water in southern New Jersey, samples were taken from various zones at numerous locations. The results were found to be very rich, as the following list will show.

#### FAUNAL LIST

The symbols after specific names have the following significance: a, psammobiotic<sup>2</sup>; b, psammophile; c, psammoxene; 1, superabundant, occurring in large numbers; 2, common, evenly scattered; 3, few, here and there; 4, rare, isolated specimens; 5, very rare, fortuitous; \* found also in Poland.

*Ascomorpha agilis* Zacharias, c, 4

*Ascomorpha agilis* var. *americana* Beauchamp, c, 5

*Ascomorpha ecaudis* Perty, c, 4

*Ascomorpha salians* Bartsch, c, 4,\*

*Aspella aper* (Harring), c, 3 to 4

*Aspella bellista* Harring and Myers, c, 4

*Aspella circinator* (Gosse), c, 4

*Aspella egregia*, new species, a, 3 to 4

<sup>1</sup> Wiszniewski, 1934, Arch. Hydrobiol. Ichthyol., VIII, p. 228.

<sup>2</sup> The terms proposed by Wiszniewski for groups of rotifers inhabiting the psammolittoral are: "psammobiotic," sand living rotifers, found nowhere else except fortuitously; "psammophile," sand loving rotifers, found also in the littoral regions among aquatic vegetation; "psammoxene," sand alien rotifers, mostly limnetic and plankton species, found only in the above two zones fortuitously.

- Aspelta imbuta* Harring and Myers, c, 5  
*Brycella tenella* (Bryce), b, 2, \*  
*Cephalodella apocolea* Myers, b, 2 to 3, \*  
*Cephalodella auriculata* (Müller), b, 2 to 1, \*  
*Cephalodella compacta* Wiszniewski, a, 2, \*  
*Cephalodella elongata* Myers, b, 3  
*Cephalodella eva* (Gosse), c, 4, \*  
*Cephalodella exigua* (Gosse), b, 2, \*  
*Cephalodella forficula* (Ehrenberg), c, 5, \*  
*Cephalodella galbina* Myers, c, 5  
*Cephalodella gibba* (Ehrenberg), b, 2 to 1, \*  
*Cephalodella gracilis* (Ehrenberg), c, 3, \*  
*Cephalodella innesi* Myers, c, 5  
*Cephalodella inquilina* Myers, c, 3 to 4  
*Cephalodella intuta* Myers, c, 3  
*Cephalodella megalocephalia* (Glascott), c, 4, \*  
*Cephalodella mucronata* Myers, c, 4  
*Cephalodella physalis* Myers, c, 4  
*Cephalodella remanei* Wiszniewski, b, 4, \*  
*Cephalodella tantilla* Myers, b, 3 to 4  
*Cephalodella tenuior* (Gosse), c, 4, \*  
*Colurella obtusa* (Gosse), b, 2 to 3, \*  
*Colurella tessellata* (Glascott), c, 4  
*Cyrtonia tuba* (Ehrenberg), c, 5  
*Dicronella gracilis*, new genus, new species, a, 4  
*Dicranophorus artamus* Harring and Myers, b, 2 to 3  
*Dicranophorus capucinus* Harring and Myers, b, 2 to 3  
*Dicranophorus edestes* Harring and Myers, c, 4, \*  
*Dicranophorus haueri* Harring and Myers, c, 5  
*Dicranophorus hercules* Wiszniewski, a, 2 to 3, \*  
*Dicranophorus hercules* var. *capucinoides* Wiszniewski, a, 2 to 3, \*  
*Dicranophorus hütkeni* (Bergendal), b, 2, \*  
*Dicranophorus proclastes* Harring and Myers, c, 5  
*Dicranophorus robustus* Harring and Myers, c, 4, \*  
*Dicranophorus rostratus* (Dixon-Nuttall and Freeman), b, 3 to 4  
*Dicranophorus thysanus* Harring and Myers, c, 5  
*Dissotrocha macrostyla* (Ehrenberg), c, 4  
*Diurella bidens* Lucks, c, 4  
*Diurella brachyura* (Gosse), c, 4  
*Diurella cavia* (Gosse), c, 3 to 4  
*Diurella collaris* (Rousselet), c, 4  
*Diurella edmondsoni*, new species, c, 4  
*Diurella insolens*, new species, a, 2 to 1  
*Diurella intermedia* (Stenroos), c, 4, \*  
*Diurella porcellus* (Gosse), c, 3 to 4, \*  
*Diurella stylata* Eyferth, c, 4  
*Diurella tenuior* (Gosse), c, 4, \*  
*Diurella tigris* (Müller), b, 3 to 4



- Diurella uncinata* Voight, b, 3 to 4, \*  
*Diurella tortuosa*, new species, b, 3 to 4  
*Elosa worralli* Lord, b, 2 to 3  
*Encentrum felis* (Ehrenberg), c, 4  
*Encentrum insolitum*, new species, a, 2  
*Encentrum lacidum* Harring and Myers, c, 5 (brackish water, Mullica River)  
*Erignatha clastopis* (Gosse), c, 5  
*Euchlanis alata* Voronkov, c, 5  
*Euchlanis arenosa* new species, a, 2 to 1  
*Euchlanis callysta* Myers, c, 5  
*Euchlanis meneta* Myers, c, 3 to 4  
*Euchlanis parva* Rousselet, c, 3 to 4  
*Euchlanis pellucida* Harring, c, 5  
*Gastropus hytopus* (Ehrenberg), c, 5  
*Gastropus minor* (Rousselet), b, 3 to 4  
*Gastropus styliifer* Imhof, c, 4, \*  
*Keratella cochlearis* (Gosse), c, 3 to 4, \*  
*Keratella serrulata* (Ehrenberg), c, 4  
*Lecane agilis* (Bryce), c, 4  
*Lecane aquila* Harring and Myers, c, 5  
*Lecane clara* (Bryce), b, 2 to 3, \*  
*Lecane flexilis* (Gosse), b, 2 to 3, \*  
*Lecane inquieta*, new species, a, 1 to 2  
*Lecane ligona* (Dunlop), c, 5  
*Lecane mira* (Murray), c, 4  
*Lecane mucronata* Harring and Myers, a, 1 to 2  
*Lecane pertica* Harring and Myers, c, 5  
*Lecane pyrrha* Harring and Myers, c, 5  
*Lecane stichaea* Harring, c, 3  
*Lecane tenua*, new species, a, 3  
*Lepadella benjamini* Harring, c, 5  
*Lepadella ovalis* (Müller), b, 3, \*  
*Lepadella patella* (Müller), b, 3, \*  
*Lepadella venefica* Myers, c, 4  
*Lindia annecta* Harring and Myers, c, 2 to 3  
*Microcodon clavus* Ehrenberg, c, 5  
*Microcodides chlaena* (Gosse), c, 5  
*Monommata astia* Myers, b, 3 to 4, \*  
*Monommata diaphora* Myers, c, 5  
*Monommata grandis* Tessin, c, 5  
*Monommata longiseta* (Müller), c, 5  
*Monostyla bulla* var. *styrax* (Harring and Myers), c, 4  
*Monostyla closterocerca* Schmarda, c, 3 to 4, \*  
*Monostyla hamata* Stokes, c, 4, \*  
*Monostyla lunaris* (Ehrenberg), b, 2 to 3, \*  
*Monostyla mitella*, new species, a, 2 to 3  
*Monostyla psammophila* Wiszniewski, a, 4, \*  
*Monostyla pygmaea* Daday, c, 4

*Monostyla quadridentata* Ehrenberg, c, 5  
*Monostyla scutata* Harring and Myers, c, 4, \*  
*Myersina tetraglena* Wiszniewski, a, 3 to 4, \*  
*Notommata cerebrus* (Gosse), c, 4  
*Notommata contorta* Stokes, c, 5  
*Notommata fasciola* Myers, c, 5  
*Notommata diasema*, new species, a, 3 to 4  
*Notommata galena* Harring and Myers, c, 5  
*Notommata pachyura* (Gosse), c, 5  
*Notommata saccigera* Ehrenberg, c, 4  
*Notommata tripus* Ehrenberg, b, 2 to 3  
*Ploesoma lenticulare* (Herrick), c, 5  
*Ploesoma truncatum* (Levander), c, 5  
*Polyarthra trigla* (Ehrenberg), c, 3, \*  
*Proales decipiens* (Ehrenberg), c, 3 to 4  
*Proales doliaris* (Rousselet), c, 3 to 4  
*Proales granulosa* Myers, c, 5  
*Proales sordida* Gosse, c, 5  
*Resticula melandocus* (Gosse), c, 5  
*Rotaria rotatoria* (Pallas), b, 3, \*  
*Rotaria sordida* (Western), c, 4  
*Rotaria tardigrada* (Ehrenberg), c, 5, \*  
*Rousseletia corniculata* Harring, c, 5  
*Squatinella longispina* (Tatem), c, 5  
*Synchaeta longipes* Gosse, c, 5  
*Synchaeta oblonga* Ehrenberg, c, 5, \*  
*Synchaeta pectinata* Ehrenberg, c, 5  
*Synchaeta stylata* Wierzejski, c, 5  
*Synchaeta tremula* (Müller), c, 5, \*  
*Taphrocampa annulosa* Gosse, b, 2 to 3, \*  
*Testudinella dicella* Myers, c, 5  
*Testudinella epicopta* Myers, c, 5  
*Testudinella incisa* (Ternetz), c, 4  
*Trichocerca bicristata* (Gosse), c, 5  
*Trichocerca longiseta* (Schränk), c, 4  
*Trichocerca multicrinis* (Kellicott), c, 5  
*Trichocerca rattus* (Müller), c, 5  
*Trichotria eukosmeta* Myers, a, 2 to 3  
*Trichotria tetractis* (Ehrenberg), c, 3, \*  
*Trichotria tetractis* var. *caudata* (Lucks), c, 5  
*Wierzejskiella velox* Wiszniewski, a, 4, \* (also from Piseco Lake, New York)

The above list contains 145 species, 44 of which have been recorded from Poland. There are 37 species from Poland that have not been found in New Jersey, making a total of 182 species from the psammolittoral of both countries.

In looking over the combined lists, one is struck by the total absence

of the cosmopolitan genus *Brachionus*. This is not surprising for the pine-barren area of New Jersey, as the genus belongs to the alkaline water fauna and is only found fortuitously in acid water. Their total absence in the alkaline psammolittoral of Poland is significant, especially as the closely related genus *Notholca* is represented by three species.

There are 12 typically alkaline water species on the Poland list, in so far as our knowledge of the limits of this group goes, while there are only 2 on the New Jersey list. There are 2 typically acid water species on the Poland list, while there are 37 from New Jersey. This is not surprising when we consider the respective hydrogen-ion concentration of the two associations.

From the combined faunal lists we find there are 27 psammobiotic species, inhabiting the psammolittoral. They appear rarely in other habitats and then only fortuitously as stragglers. They are:

*Aspelta egregia* Myers  
*Cephalodella compacta* Wiszniewski  
*Cephalodella megalotrocha* Wiszniewski  
*Dicranella gracilis* Myers  
*Dicranophorus hercules* Wiszniewski  
*Dicranophorus hercules* var. *capucinoides* Wiszniewski  
*Dicranophorus leptodon* Wiszniewski  
*Diurella insolens* Myers  
*Diurella pygocera* Wiszniewski  
*Diurella taurocephala* Hauer  
*Eloea spinifera* Wiszniewski  
*Encentrum diglandula* (Zawadowski)  
*Encentrum insolitum* Myers  
*Euchlanis arenosa* Myers  
*Lecane inquieta* Myers  
*Lecane levistyla* (Olofsson)  
*Lecane mucronata* Hanning and Myers  
*Lecane tenua* Myers  
*Lindia janickii* Wiszniewski  
*Monostyla mitella* Myers  
*Monostyla psammophila* Wiszniewski  
*Myersina tetraglena* Wiszniewski  
*Notommata diasema* Myers  
*Trichotria eukosmela* Myers  
*Wierzejskiella sabulosa* Wiszniewski  
*Wierzejskiella velox* Wiszniewski  
*Wigrella depressa* Wiszniewski

New species described in this paper, as additions to the above fauna, are as follows:

*Dicranella gracilis*  
*Aspella egregia*  
*Encentrum insolitum*  
*Notommata diasema*  
*Diurella insolens*

*Diurella edmondsoni*  
*Diurella tortuosa*  
*Euchlanis arenosa*  
*Lecane inquieta*  
*Lecane tenua*

*Monostyla mitella*

## ORDER MONOGONONTA

### Family Dicranophoridae

#### DICRANELLA, NEW GENUS

Notommatid rotifers with elongate, cylindric, illoricate body, with a well-marked neck separating the head from the abdomen. Posteriorly the body tapers to a conical foot terminated by two acute, rudimentary toes. There are no indications of a foot joint, but atrophied foot glands are present.

The corona is oval and oblique. The marginal cilia are short with the exception of two lateral auricle-like tufts of longer cilia. There is a small rostrum present which is not enclosed by the marginal ciliation. The buccal field is evenly ciliated.

The mastax is of the forcipate type and asymmetric. The rami are roughly lyrate, terminating in two blunt teeth. The unci have one tooth firmly united to the tips of the rami; the manubria are asymmetric and long. The fulcrum is short and lamellar.

There are two small subcerebral glands, but no retrocerebral sac is present. Eyespots are absent.

#### *Dicranella gracilis*, new species

Figures 1, 2, 3, 18

The body is elongate, cylindric, slightly convex dorsally and straight ventrally. The integument is very flexible and the rotifer is always hyaline.

The head is separated from the abdomen by a distinct constriction. The corona is oblique, and has moderately long auricle-like tufts of cilia for propulsion. The rostrum is short, broad and rounded anteriorly. The abdomen is elongate and tapers gradually to the small tail. The integument is marked posteriorly by two distinct skin folds. The foot and rudimentary toes are confluent and without joints. The toes are short and very acute; they are incapable of movement and, in this case, merely furcate caudal appendages. There are remnants of foot glands but no ducts.

The mastax is of modified forcipate type. The trophi are rather small and stout. The rami are irregularly lyrate and each terminates in two blunt teeth. Attached to the left ramus is a very large subsquare alula; there is none present on the right ramus. The unci each have a single large tooth, clubbed at the tip. The manubria are long and stout, the left being much longer than the right, and it is strongly incurved posteriorly; no basal plates are present. The fulcrum is a short lamellar plate which gradually diminishes in width and is acutely pointed distally.

The antennae are normal and in the usual positions.

The gastric glands are oval and of medium size. There is no constriction between the stomach and the intestine. The ovary and bladder are normal.

The ganglion is long and saccate; anteriorly there is a very small pair of subcerebral glands. Neither retrocerebral sac nor eyespots are present.

Total length, 200–210 $\mu$ .

*Dicranella gracilis* was found sparingly in the hygrosummon of Lenape Lake, during the month of September. The posterior portion of the body strongly resembles some of the species of *Gastrotricha*, due to the presence of caudal appendages instead of toes—the only instance of its kind among the *Rotifera*. As the species has only been found in the hygrosummon, it is probably psammobiotic.

Cat. No. A. M. N. Hist. 766, cotype.

The male bears little resemblance to the female. The toes are bulbous at the base and end in bristle-like tips.

Cat. No. A. M. N. Hist. 787.

### Family Dicranophoridae

#### *Aspelta egregia*, new species

Figures 6, 7

The body is moderately elongate, fusiform, gibbous dorsally and straight ventrally. The integument is very thin and the outline changes constantly with the incessant contortions of the individual.

The head is long and separated from the abdomen by a well-marked neck fold. The corona is ventral, with prominent lateral auricle-like tufts of longer cilia. The rostrum is prominent, broad at the base, rounded anteriorly and slightly decurved. The abdomen is moderately long, gibbous dorsally, deepest beyond mid-length, from whence it tapers gradually to the small tail. The integument is marked posteriorly by two circular skin folds. The foot is small and conical. The toes are moderately long, parallel-sided and end in acute tips.

The mastax is of modified forcipate type. The trophi are small, somewhat elongate and highly asymmetric. The rami are narrow at the base, and the left terminates in a stout hook-shaped anterior tooth; they have prominent alulae which originate in the central portion, then curve outward and protrude somewhat ventrally. The unci are rudimentary. The right uncus has one branch resting on the manubrium and two on the ramus, while the left uncus has one branch resting on the ramus attached to a lamellar plate that slides along the ramus directly below it. The manubria are long, fairly stout and somewhat undulate. The fulcrum is a lamellar plate, wide at the base, from whence it diminishes rapidly near mid-length, ending in a long blunt prolongation.

The oesophagus is short. The gastric glands are small and oval. The stomach and intestine are not distinctly separated. The ovary and bladder are normal. The foot glands are stout and pyriform.

The antennae are normal and in the usual positions.

The ganglion is large and saccate, and has a ductless retrocerebral sac attached to its posterior end. Subcerebral glands and eyespots are absent.

Total length, 315–325 $\mu$ ; toes, 45–50 $\mu$ .

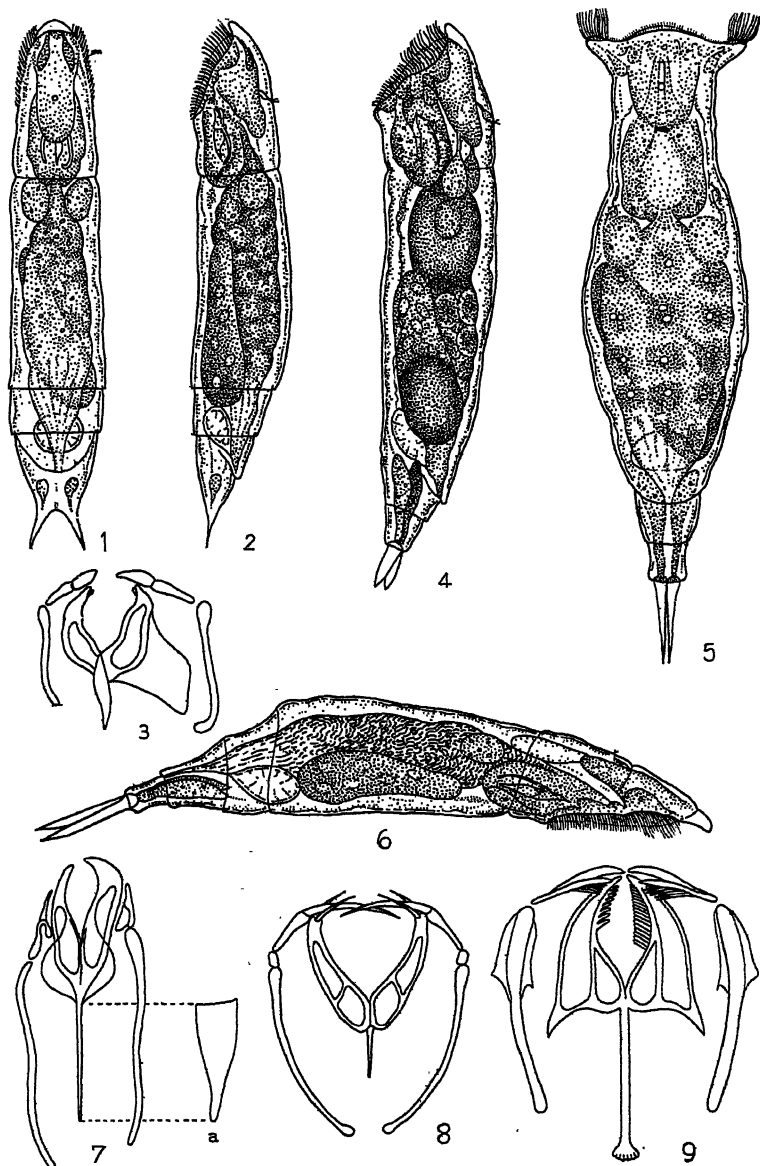


Fig. 1. *Dicranella gracilis*, dorsal view. Fig. 2. *Dicranella gracilis*, lateral view. Fig. 3. *Dicranella gracilis*, trophi, ventral view. Fig. 4. *Encentrum insolitum*, lateral view. Fig. 5. *Notommata diasema*, dorsal view. Fig. 6. *Aspella egregia*, lateral view. Fig. 7. *Aspella egregia*, trophi, ventral view; a, fulcrum. Fig. 8. *Encentrum insolitum*, trophi, ventral view. Fig. 9. *Notommata diasema*, trophi, ventral view.

*Aspelta egregia* was found sparingly in the hygropsammon of Lenape and Union Lakes, during the summer and fall. It was never abundant, but some specimens occurred in many collections. The species bears a certain resemblance to *Aspelta beltista* Harring and Myers, but differs in the shape of the toes, the absence of eyespots and the elements of the trophi. As it has consistently been found in the hygropsammon and nowhere else, it is without doubt a psammobiotic species.

Cat. No. A. M. N. Hist. 780, cotype; trophi, 804.

### Family Dicranophoridae

#### *Encentrum insolitum*, new species

Figures 4, 8

The body is elongate, cylindric and fairly stout. The integument is flexible and the general shape is rather constant.

The head is short and separated from the abdomen by an indefinite constriction. The corona is oblique, and the rostrum is short and rounded anteriorly. The abdomen is elongate, tapering gradually from the neck to the toes. The foot is short and conical. The toes are very short and cylindrical, ending in abrupt tips.

The mastax is of modified forcipate type. On each side of the mouth opening there are a pair of prominent salivary glands. The trophi are relatively small. The rami are lyrate and broad at the base; the tips are blunt and each culminate in two long slender teeth. No alulae are present. The unci are long, slender and somewhat curved; they rest on the rami between the terminal teeth. The intramallei, linking the unci with the manubria, are very small. The manubria are long, slender, incurved and somewhat expanded posteriorly. The fulcrum is short and lamellar.

The gastric glands are small and oval. The posterior portion of the oesophagus is greatly expanded, forming a huge proventriculus. The ovary and bladder are normal. The foot glands are very stout, long and pyriform.

The antennae are normal and in the usual positions.

The ganglion is large and saccate. On both sides, near the posterior end, are two pendant subcerebral glands, each attached by a long tubule to the sac. No eyespots are present.

Total length, 240 $\mu$ ; toes, 15 $\mu$ .

*Encentrum insolitum* was collected in the hygropsammon of Lenape Lake in January, 1935. It is evidently a psammobiotic winter species, having been found several times when the absence of ice permitted. Although there are a number of closely related and similar species, this differs from any of them by the presence of the expanded posterior portion of the oesophagus, as well as by the peculiar subcerebral glands, assuming these organs are such, judging by analogous organs in closely related species.

As these rotifers were almost impossible to narcotize, "cooking" was resorted to. The specimens were placed in a watch glass containing a small amount of water. When fully expanded, they were suddenly flooded with boiling water. This has a tendency to swell the individuals, but has the advantage of obtaining them expanded. The rotifers partially regain their normal shape after being infiltrated. Allowances should be made for this in the Museum material.

Cat. No. A. M. N. Hist. 800, holotype; trophi, 804.

Family **Notommatidae**  
**Notommata diasema**, new species

Figures 5, 9, 16

The body is cylindric and rather stout. The integument is very transparent, and the outline varies considerably with the incessant contractions of the individual.

The skin folds limiting the neck are evanescent although this portion is well marked. The trunk increases rather abruptly in breadth, then tapers gradually to the small tail which has one round lobe. The foot is long and has two joints of about equal length. The toes are nearly as long as the foot; from the dorsal view, they are slender and almost straight, slightly enlarged at the base, then tapering gradually, ending in very slender, drawn out tips.

The corona is of the normal *Notommata* type. The auricles are rather small and carry locomotor cilia which are continuous with the circumapical band.

The mastax is of the virgate type. The trophi are robust and symmetric. The ventral portion of the rami are triangular and the opening between them is broadly fusiform. The inner edge of the left ramus is finely denticulate, while the right edge is disposed into eight or ten short, blunt teeth. The unci have five or six preuncial teeth attached to the ventral tooth which, in this case, is shorter than the second tooth, which is followed, in turn, by a slender rudimentary tooth, all being attached to an oval, lamellar basal plate. The manubria are stout and nearly straight, with a broad subsquare lamella at their base. The fulcrum is long and tapers toward the posterior end, which is expanded and incurved.

The stomach is large and the clear intestine is relatively small. The gastric glands, ovary and bladder are normal. The foot glands are very long and stout.

The antennae are normal and in the usual positions.

The ganglion is large and saccate. The retrocerebral sac is long, clear and pyriform, the duct of which could not be traced to the openings on the apical area. The subcerebral glands are elongate and fusiform; their length is little more than one-half that of the sac including the duct. The eyespot is situated at the posterior end of the ganglion.

Total length, 312 $\mu$ ; toes, 42 $\mu$ .

*Notommata diasema* was found sparingly in the hygrosummon of Lenape Lake, on several occasions during the summer. As it had been collected previously among aquatic vegetation in the littoral region, it is a psammophile species.



Although there are a number of closely related species, the toes and the trophi are enough to differentiate this from any other member of the genus.

Cat. No. A. M. N. Hist. 777, holotype.

Family Notommatidae  
Subfamily Trichocercinae  
*Diurella insolens*, new species

Figures 11, 13, 15, 19

The body is very stout, evenly arched dorsally and nearly straight ventrally. The posterior portion diminishes rapidly from above the intestine and ends in a prominent cylindrical prolongation. The integument is quite thin and flexible.

The head is very large and separated from the abdomen by a distinct constriction which nearly disappears when the rotifer contracts. Besides having several longitudinal plaits of the head sheath, there are two characteristic mucrones; the left is long and acutely pointed, while the right is shorter and very wide at the base. The corona consists of a marginal circle of long cilia and several perioral tufts of sensory setae. There are no palplike protuberances on the apical area. The foot is very short and is situated on the ventral side of the body. The foot opening is shaped somewhat like a calabash, with the elongate basal portion directed posteriorly. The toes are directed forward and frequently held retracted within the lorica. The right toe is equal to about one-fourth the length of the body, while the left is somewhat shorter. There is a stout substyle, nearly as long as the left toe, giving an appearance of three toes.

The mastax is modified virgate in type; it is huge and extends posteriorly as far as the middle of the abdomen. The right malleus is bacilliform and much reduced; the left is very stout, and the manubrium has a large terminal hook directed inwards and ventrally. The left uncus is stout and bifid near the tip. The left ramus is prolonged into an acute triangular alula, while the right is slender and much shorter. The left subuncus is composed of three or four slender diverging teeth; the right is composed of five or six, which are much shorter and more slender. There is a long thin rod attached to and supporting the left uncus; its distal end rests in a depression on the base of the left alula. The fulcrum is very long, lamellar, and has a large terminal expansion.

The dorsal antenna is situated above the ganglion to the left of the median line of the body. The lateral antennae are in the normal position.

The gastric glands and bladder are very small and round, the bladder being situated above and behind the foot. On account of the great size of the mastax, the anterior portion of the ovary, which is frequently huge, is often displaced dorsally, embracing the stomach and giving an appearance of the stomach being underneath.

The ganglion is long and saccate, and has a round eyespot attached to its posterior end. There is also a paler frontal eyespot, composed of scattered pigment particles, which is situated on the apical area.

Total length, 170-180 $\mu$ ; left toe, 40-50 $\mu$ .

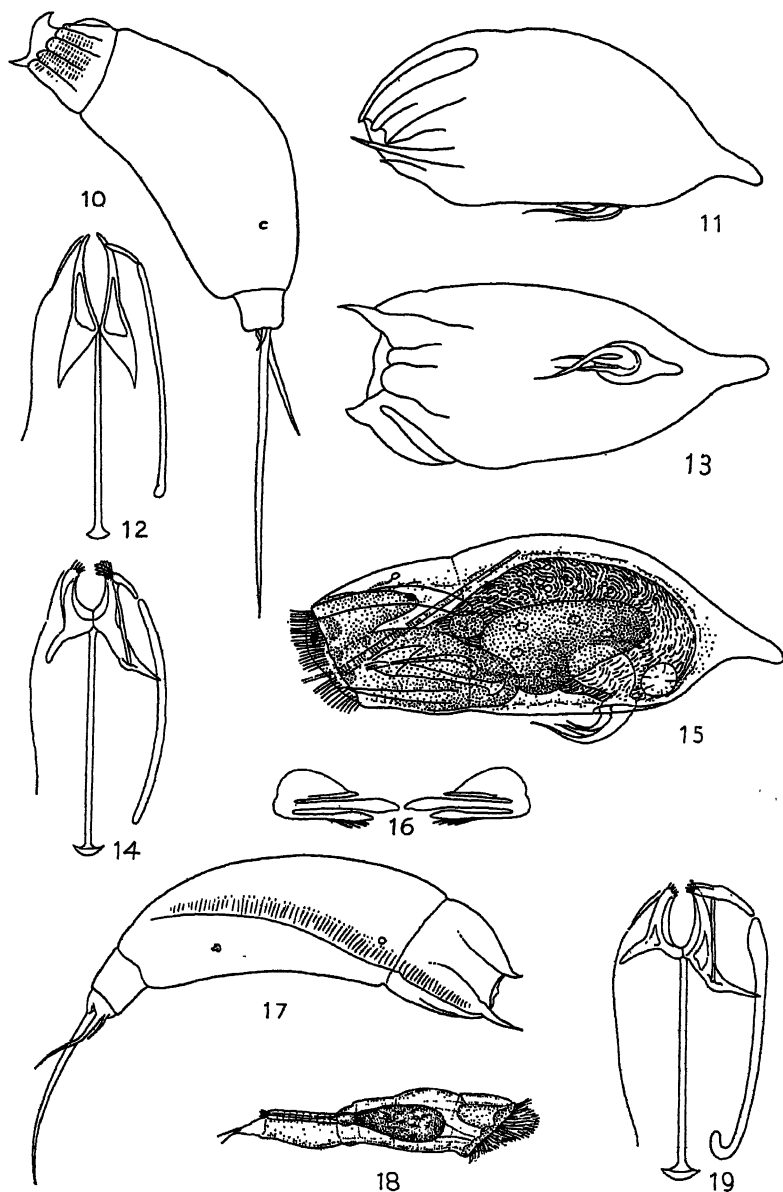


Fig. 10. *Diurella edmondsoni*, lateral view. Fig. 11. *Diurella insolens*, lorica, lateral view. Fig. 12. *Diurella edmondsoni*, trophi, ventral view. Fig. 13. *Diurella insolens*, lorica, ventral view. Fig. 14. *Diurella tortuosa*, trophi, ventral view. Fig. 15. *Diurella insolens*, expanded specimen, lateral view. Fig. 16. *Notommata diasema*, unci, frontal view. Fig. 17. *Diurella tortuosa*, dorsal view. Fig. 18. *Dicranella gracilis*, male, lateral view. Fig. 19. *Diurella insolens*, trophi, ventral view.

*Diurella insolens* was superabundant in the hygropsammon of both Lenape and Union Lakes, during the summer months. The number of individuals grew less during September and October, disappearing entirely in November. It has certain affinities with the genus *Elosa*, which are as follows:

*Diurella insolens*

1. Lorica thin, somewhat flexible
2. Frontal mucrones present
3. Trophi highly asymmetric
4. Two eyespots
5. Digitiform posterior prolongation of lorica present
6. No coronal palps
7. Foot opening conspicuous; foot and toes frequently carried within the lorica

*Elosa*

1. Lorica thin, somewhat flexible
2. Frontal mucrones absent
3. Trophi highly asymmetric
4. Two eyespots
5. Posterior toothlike projection of lorica present or absent
6. No coronal palps
7. Foot opening present; foot and toes absent

From the above we see that *Diurella insolens* may well be considered an intermediate species, showing the close relationship between the genera *Diurella* and *Elosa*. This analogy is not uncommon among the rotifers, as is seen in the genera *Asplanchna* and *Asplanchnopus*, where the salient difference consists of the presence or absence of a foot and toes, these two genera being linked together by *Asplanchna harricki* de Guerne, which species has remnants of foot glands, the foot and toes being absent.

*Diurella insolens* is so distinctive in appearance that it is easily recognized whenever seen. As it has only been found in the hygropsammon, it is undoubtedly a psammobiotic species.

Cat. No. A. M. N. Hist. 762, cotype; trophi, 789.

*Diurella edmondsoni*, new species<sup>1</sup>

Figures 10, 12

The body is elongate, twisted, cylindric and rather stout. The head is small and is characterized by the presence of a prominent, projecting plate on the right side, bounded dorsally and ventrally by acute diverging mucrones. The head sheath is distinctly set off from the abdomen and is marked by five longitudinal plaits at which the sheath folds when the head is withdrawn. There is no body ridge nor striated area, although the individual plaits of the head sheath are plainly striated. The foot is rather small and sharply set off from the body. The left toe is long and straight; the right is about two-fifths the length of the left and is straight and relatively very stout.

The mastax is modified virgate in type, and the trophi are simple. The right malleus is very slender and bacilliform, the left being much stouter. The left uncus

<sup>1</sup> Dedicated to Mr. Thomas Edmondson, New Haven, Connecticut.

is composed of a single tooth. The left manubrium is long, stout, slightly curved and somewhat expanded posteriorly. The rami are triangular, and symmetric, which is quite unusual in this genus. The alulae are large and approximately equal in size. There is no subuncus present. The fulcrum is long, lamellar and expanded posteriorly.

The antennae are normal and in the usual positions. The internal organs are normal.

Length of body including foot,  $150\mu$ ; left toe,  $120\mu$ ; right toe,  $45\mu$ .

*Diurella edmondsoni* was collected sparingly in the hygrosummon of Lenape Lake, during the months of September and October. It has also been found among aquatic vegetation in the littoral region of several bodies of water in the Pine-barrens. It is fortuitous in the hygrosummon and is a psammoxene species. The projecting plate on the right side of the head, the symmetric rami and the very stout right toe are characteristic. The only other instance of a lateral projecting head plate is in *Diurella weberi* Jennings. In that species the plate is evenly rounded and is situated on the left side instead of the right.

Cat. No. A. M. N. Hist. 468, holotype.

#### *Diurella tortuosa*, new species

Figures 14, 17

The body is elongate, twisted, cylindric and rather stout; it is widest anteriorly, from whence it tapers gradually to the foot. The head is large and the sheath is marked by two prominent mucrones situated on the dorsal side. The left mucro is long and acute, the right short and divergent. Ventrally, the head sheath is composed of five or six rather indistinct plaits. A low dorsal ridge extends posteriorly from the base of the longer tooth and reaches nearly to the foot. Along the left side of the ridge there is a well marked striated area. The foot is fairly stout and sharply set off from the body. The left toe is somewhat curved and equal to about one-half the length of the lorica. The length of the right toe is equal to about one-half that of the left.

The mastax is of modified virgate type, and the trophi are highly asymmetric. The right malleus is atrophied and bacillar; the left being very robust. The left uncus is provided with three fairly stout teeth, and the subuncus is composed of four or five blunt slender teeth. The right subuncus is composed of five or six short needle-like teeth. Attached to the middle portion of the left uncus is a long slender rod, the distal tip of which rests on the left alula. The rami are roughly triangular. The right alula is elongate and prolonged posteriorly; the left is much longer, and the tip is drawn out into an acute triangle. The fulcrum is very long, lamellar and expanded posteriorly.

The antennae are normal and in the usual positions.

Length of body including foot,  $180\mu$ ; left toe,  $84\mu$ ; right toe,  $43\mu$ .

*Diurella tortuosa* was found sparingly in the hygrosummon of Lenape and Union Lakes, during the spring and summer. It is a

psammophile species, being common among aquatic vegetation in the littoral region of various bodies of water in numerous locations. It bears a certain resemblance to *Diurella myersi* Hauer. In that species the head is small and the posterior portion of the body by far the stoutest, which condition is exactly reversed in *Diurella tortuosa*. It also somewhat resembles *Diurella insignis* (Herrick). However, in that species the body is very long, slender and more parallel-sided.

Cat. No. A. M. N. Hist. 792, cotype.

### Family Brachionidae

#### *Euchlanis arenosa*, new species

Figures 20, 25, 26

The body is very deep and laterally compressed. From the dorsal view, it is narrow and elongate oval. The cross-section is in the form of a narrow cone, rounded at the apex.

The lorica and corona agree with the other species of the genus. The abdomen is gibbous dorsally; posteriorly it falls away abruptly, and is nearly straight ventrally. The foot is long, very slender and composed of two joints; it is protected dorsally by a shield, as in some other species of the genus. The toes are straight and stout near the base; at mid-length they diminish in depth, swelling again posteriorly, ending in a decurved clawlike tip.

The mastax is modified malleate in type. The trophi are of the *Euchlanis* type, having the usual denticular combs attached to the inner tip of each ramus. The unci are provided with four stout, club-shaped teeth.

The gastric glands are small and oval. The stomach, intestine, ovary and bladder are normal. The foot glands are long and very slender near the base.

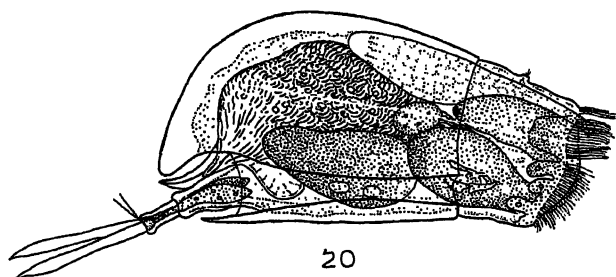
The antennae are in the normal positions, the dorsal not being as stout as in some of the species of the genus.

The retrocerebral sac is huge. It extends at least to the middle of the abdomen in living specimens; it has a tendency to contract somewhat in preserved material. The eyespot is situated at the posterior end of the ganglion.

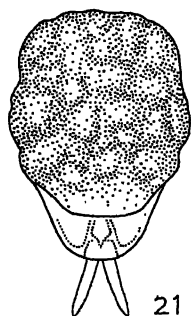
Total length, 185–225 $\mu$ ; toes, 60–70 $\mu$ . Depth of body, 90 $\mu$ . Width, 70 $\mu$ .

*Euchlanis arenosa* was superabundant in the hygropsammon of both Lenape and Union Lakes, from July until November. Its movements are extremely fast and restless, as opposed to the other species of the genus, with the possible exception of *Euchlanis alata* Voronkov. Some parasitic rotifers, such as *Pleurotrocha trypeata* (Harring and Myers), on being removed from their host, swim rapidly about as if in search of a new one. This is often the case when psammobiotic rotifers are removed from sand, in the capillary state, to clear water.

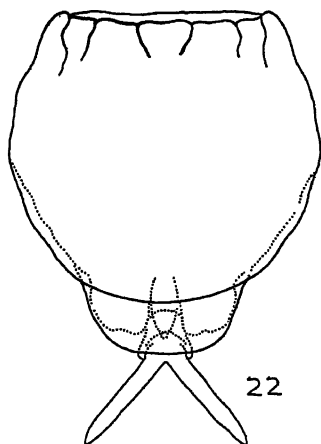
The greatly compressed body, the huge retrocerebral sac, the protective foot shield, together with the number of teeth in the unci, distinguish this from any other species of the genus. The foot shield is



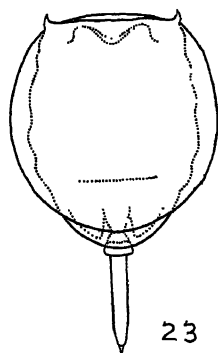
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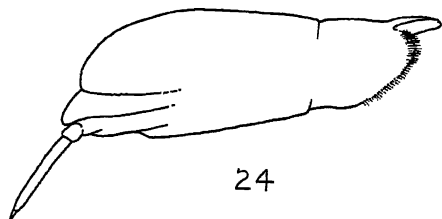
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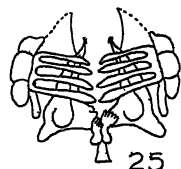
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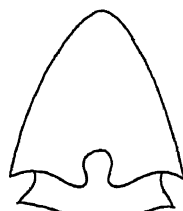
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Fig. 20. *Euchlanis arenosa*, lateral view. Fig. 21. *Lecane tenua*, dorsal view. Fig. 22. *Lecane inquieta*, dorsal view. Fig. 23. *Monostyla mitella*, dorsal view. Fig. 24. *Monostyla mitella*, expanded specimen, lateral view. Fig. 25. *Euchlanis arenosa*, trophi, ventral oblique view. Fig. 26. *Euchlanis arenosa*, lorica, cross-section.

somewhat analogous to the posterior segment in the closely related genera *Lecane* and *Monostyla*.

Cat. No. A. M. N. Hist. 754, paratype.

Family **Brachionidae**

Subfamily **Lecaninae**

***Lecane inquieta*, new species<sup>1</sup>**

Figure 22

The outline of the lorica is broadly ovate. The integument is quite flexible and the anterior margins somewhat variable. The dorsal plate is subcircular and rounded posteriorly. The ventral plate is of the same width as the dorsal for half its length, the posterior half being narrower. The lateral sulci are indistinct. The posterior segment is broad and truncate distally; it projects far beyond the dorsal plate. The coxal plates are large and distinct; they are subsquare and have a characteristic notch in the middle of the posterior edge. The first foot joint is slender and fusiform, the second large and broadly pyriform. The toes are fairly long and stout, parallel sided and slightly undulate, ending in abrupt blunt tips.

Length of dorsal plate, 96 $\mu$ ; ventral plate, 101 $\mu$ ; toes, 35 $\mu$ . Width of lorica, 90 $\mu$ .

*Lecane inquieta* was found abundantly in the hygroscammon of Lenape and Union Lakes, during the spring and summer months. Its movements, unlike most of the other species of the genus, are extremely fast and restless, giving an impression of being a forcipate notommatid. It seldom contracts in life, and must be treated with a solution of formalin in order to bring about that state, so it may be studied while fully contracted. It is a psammobiotic species.

Cat. No. A. M. N. Hist. 755, cotype.

***Lecane tenua*, new species**

Figure 21

This species, although smaller than the preceding, bears a superficial resemblance to it. The body is much more elongate, and the dorsal and ventral plates are equal in width throughout. The posterior segment is not so squarish, but more rounded and projects much farther beyond the dorsal plate. The coxal plates are prominent, bluntly pointed and not subsquare, as in the preceding species. The toes are relatively short, parallel sided and end in obtuse tips.

Length of dorsal plate, 70 $\mu$ ; ventral plate, 85 $\mu$ ; toes, 25 $\mu$ . Width of lorica, 60 $\mu$ .

*Lecane tenua* was found in the hygroscammon of Lenape and Union Lakes, during the spring and summer months. It was also found in smaller bodies of water, such as Pleasant Mills and Great Harbor

<sup>1</sup> In order to avoid duplication, the dotted lines in the figures of the genera *Lecane* and *Monostyla* should be considered as referring to details below the dorsal plate.

River at Weymouth. It is a psammobiotic species.

Cat. No. A. M. N. Hist. 750, cotype.

Family **Brachionidae**

Subfamily **Lecaninae**

***Monostyla mitella***, new species

Figures 23, 24

The outline of the lorica is broadly oval. The anterior margin of the dorsal plate is somewhat convex, while that of the ventral is straight. At the anterior, external angles are two acute frontal spines. The dorsal plate is oval and rounded posteriorly. The ventral plate is considerably narrower than the dorsal; it is somewhat flexible, and its margins undulate. The lorica is without any surface markings. The posterior segment is small and round. The coxal plates are moderately large and obtusely pointed. The first foot joint is poorly defined, while the second is fairly large and heart-shaped, projecting slightly beyond the lorica. The toe is quite long and the edges are parallel-sided. The claw is minute and without basal spicules; it continues the outline of the toe which is slightly constricted posteriorly.

The corona is protected dorsally by a distinct head hood, as in the related genus *Lepadella*.

Length of dorsal plate, 76 $\mu$ ; ventral plate, 80 $\mu$ ; toes, 35 $\mu$ . Width of anterior points, 40 $\mu$ ; dorsal plate, 65 $\mu$ ; ventral plate, 55 $\mu$ .

*Monostyla mitella* was common in the hygro-psammon of Lenape and Union Lakes, Great Harbor River at Weymouth, and Pleasant Mills, during the spring and summer. This species, together with *Monostyla galeata* Bryce, are the only members of the genus possessing a head hood. It differs from *Monostyla galeata* by the presence of lateral anterior spines, by the slightly convex dorsal margin, by the claw without basal spicules and by the posterior segment, which is round and rather small, while in the Bryce species it is very prominent, truncate posteriorly and projects far beyond the dorsal plate. *Monostyla galeata* is a rotifer of the *Sphagnum* fauna, while *Monostyla mitella* is a psammobiotic species.

Cat. No. A. M. N. Hist. 752, 754, paratypes.

There are 82 species of psammolittoral rotifers recorded from Poland, while herein are recorded 146 species from southern New Jersey. This is not surprising in view of the fact, as pointed out by Harring and Myers, that alkaline water associations contain countless individuals but relatively few species, while acid water associations contain relatively few individuals divided among many species. In the spring of 1924, eighty-four species of rotifers were recorded during one day's collecting among submerged and floating *Sphagnum* and *Utricularia*, along the shores of Lenape Lake. During three months, collections were made



almost daily in the alkaline waters of southern California, and only 106 species were found.

When a species is found only in the hygropsammon or the eupsammon and nowhere else, not even in collections from the littoral region taken over a period of time, it is safe to assume it is psammobiotic.

Some rotifers get into the moist sand of the hygropsammon because the eggs of duration are washed up by the waves, or left there by changes in the water level, afterward hatching out. Others are also washed there directly by wave action. These are generally psammoxene species; they find conditions of existence unbearable and soon perish. Many rotifers, getting into the sand by the above means, find conditions of existence favorable; they thrive in the environment as well as in the littoral region among aquatic vegetation of the body of water itself. These are psammophile rotifers. Some rotifers exist only in the hygro-psammon or the eupsammon or both, which is their natural habitat. They are found nowhere else, except fortuitously and are psammobiotic species.

On account of their small size, most rotifers are not specially adapted to a psammolittoral existence. The adaptation to the environment in some of them, however, is manifest in various ways, including a life in the thin layer of water between the grains of sand, resulting in great dorsoventral or lateral compression, as *Euchlanis arenosa*, *Wigrella depressa*, *Wierzejskiella sabulosa* and *Cephalodella remanei*. Many have the power of adhering firmly, resulting in strongly developed foot glands, as *Euchlanis arenosa*, *Aspelta egregium* and *Encentrum insolitum*. While there are no special adaptations for swiftness of movement, a number of psammobiotic species are notable for the rapidity in which they move about, such as *Euchlanis arenosa*, *Trichotria eukosmeta*, *Diurella insolens* and *Lecane inquieta*.

The number of psammophile species found in the hygropsammon is influenced by the proximity of marginal aquatic vegetation, especially *Sphagnum*, *Utricularia* and other plants with finely dissected leaves. If there is little marginal vegetation the number of such species will be relatively few, while the number of psammobiotic species will remain approximately constant.

In comparing the psammolittoral rotifers of Poland with those of southern New Jersey, it is evident the fauna of alkaline bodies of water differs markedly from similar acid water associations. The result of investigating the psammolittoral clearly shows the presence of a distinct rotatorian fauna hitherto unsuspected, and rich in species adapted to a life in the water contained between the grains of sand.

## NOTES ON SPECIES

*Trichotria eukosmeta* Myers

*Trichotria eukosmeta* MYERS, 1934, American Museum Novitates, No. 761, p. 6, Figs. 13, 14.

A few specimens of this species were collected in algae growing on sand in very shallow water, near the southern margin of Faun Pond, Mount Desert Island, Maine, during the summer of 1926. Not enough material was found at that time to make a thorough study of its habits.

During the months of August and September of 1934, this species was found in abundance in the hygropsammon of both Lenape and Union Lakes. There is no doubt, therefore, about its being a psammobiotic species. Its occurrence in the algae of Faun Pond was merely fortuitous.

*Lecane mucronata* Harring and Myers

*Lecane mucronata* HARRING AND MYERS, 1926, Trans. Wis. Acad. Sci. Arts Lett., XXVI, p. 330, Pl. XXIX, figs. 3, 4.

During the month of September this species was found in superabundance in the hygropsammon of Union Lake. It was previously considered to be rare although widely distributed. It resembles *Lecane inquieta* in movement, being rapid and seldom contracting. It was found at Batsto, New Jersey, in 1924 among algae growing on sand in shallow water; the same kind of environment in which *Trichotria eukosmeta* was originally found. In view of the above facts, it is without doubt a psammobiotic species.

*Lepadella triptera* var. *alata* Myers

*Lepadella triptera* var. *alata* MYERS, 1934, American Museum Novitates, No. 760, p. 10, Figs. 29-32.

In a recent communication from J. Hauer, Karlsruhe, Germany, he called my attention to the fact that he found this variation in collections from Fundort, Sumatra, and not from near Karlsruhe, as stated in the Novitates.

*Colurella aemula* Myers

*Colurella aemula* MYERS, 1934, American Museum Novitates, No. 700, p. 16, Fig. 13.

This species has been found by Hauer in a collection from near Toba-Heide, Sumatra. He observed that it has a longitudinal dorsal cleft of the lorica. I have confirmed this, and also found the cleft to

be present in the closely related species *Colurella logima*. This precludes their retention in the genus *Colurella*, in which the dorsum is always confluent with the lateral plates, and never cleft. I propose, therefore, the generic name of *Paracolurella*.

PARACOLURELLA, NEW GENUS

Body loricated, oval or ovate, laterally compressed; lorica of two lateral plates, open anteriorly and posteriorly, longitudinally cleft dorsally and open ventrally; frontal head hood present; foot of three joints, the terminal being as long or longer than the combined length of the basal and second joints; foot terminated by two toes; mastax malleate.

*Paracolurella* is an intermediate genus, partaking of the characters of both *Colurella* and *Mytilina*.





# AMERICAN MUSEUM NOVITATES

Number 831

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

March 20, 1936

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## RECORDS OF WESTERN BEES

By T. D. A. COCKERELL

The holotypes of all the new forms described will be found in the American Museum.

### Andrenidae

*Andrena* (*Conandrena*) *cheyennorum* Viereck and Cockerell

Wyoming: Rawlins, alt. 6800 ft., June 26, 1920, 1♀ (Lutz); Medicine Bow, alt. 6600 ft., June 23, 1920, 2♀ (Lutz).

Idaho: Victor, alt. 6300 ft., July 11, 1920, 1♀ (Mrs. F. E. Lutz).

*Andrena mimetica* Cockerell

California: Palm Springs, March 24, at *Phacelia*, 1♀ (W. P. Cockerell); Tub Spring, Borego, March 21, at *Hyptis emoryi* Torrey, ♀ (Cockerell).

*Andrena nigrae* Robertson

Colorado: Julesburg, alt. 3460 ft., June 7, 1920, on willow and at willow flowers, 3♀ (Lutz).

*Andrena sieverti* Cockerell

Wyoming: Laramie, on Univ. of Wyoming campus, alt. 7200 ft., June 14, 1920, 6♀ (Lutz). These appeared to be a new race, having the hind tarsi, and greater part of hind tibiae, red, but in one specimen these parts are dark as in typical *A. sieverti*.

*Andrena sieverti* var. *opacicauda*, new variety

FEMALE.—Surface of abdomen dull, hardly at all shining; hind basitarsi, and greater part of hind tibiae usually, but not always, red. The dull effect is due to a dense minute sculpture, the scattered punctures of the tergites being essentially as in the typical form.

Wyoming: Laramie, on Univ. of Wyoming campus, alt. approx. 7200 ft., June 14, 1920, 16♀ (Lutz).

Had this been taken in some other locality, it would have been supposed to be a different species, but I feel sure that it is a Mendelian alternative to typical *A. sieverti*.

*A. persimilis* Graenicher is very close to *A. sieverti*, but distinct. One of the characters is in the second cubital cell, which in *A. persimilis* is narrow and parallel-sided, receiving the recurrent nervure near the end; in *A. sieverti* it is larger, contracted above, and receiving the recurrent nervure far from the end. A female from West Point, Nebraska, which Crawford had referred to *A. albovirgata* Ckll., is precisely *A. persimilis*. *A. medionitens* Ckll. is easily known from *A. sieverti* by the broader facial foveae.

*Andrena speculifera* Cockerell

Wyoming: Pine Bluffs, alt. approx. 5050 ft., June 9, 1920, 6 ♀ (Lutz).

*Nomia bolliana helenii*, new subspecies

FEMALE.—Scape, thorax, legs, and first three abdominal segments red, the third tergite somewhat dusky; area of metathorax reduced to a very brief, poorly defined, roughened surface; second cubital cell very broad, third receiving second recurrent nervure very near end.

Texas: McMullen County, 1935 (H. B. Parks). Three were sent, all from flowers of *Helenium microcephalum* D. C. One approaches the typical form in having the mesothorax and sides of thorax black.

Texas: About 12 miles south of Tilden, McMullen County, abundant on *Helenium microcephalum* D. C., collecting pollen and nectar. Also about 31 miles southeast of Carrizo Springs, in Webb County, very abundant on *Polypteris texana* (D. C.), collecting pollen and nectar (H. B. Parks).

This looks like an overgrown *N. nevadensis* Cresson, but is easily separated by the large long tegulae, sinuate on outer side, and other characters.

*Conanthalictus wilmattae*, new species

FEMALE.—Length about 5 mm., anterior wing 4; dark bluish green, including the abdomen, which has the margins of the tergites brown; head transverse, short, the clypeus with an elevated thickened black margin; mandibles with the apical third red, the rest black; antennae rather long, the flagellum bright ferruginous beneath; front dull, vertex more shining but not polished; head, thorax, and legs with thin long white hair; hair on inner side of hind tarsi reddish; legs black; mesothorax shining dark green, with a microscopically tessellate surface and scattered punctures; scutellum shining, a rather yellower green; area of metathorax large, dull, minutely roughened, with a few very weak plicae at base, the rounded hind margin shining; tegulae very dark brown; wings hyaline, the pale yellowish stigma with a dark margin; second cubital cell extremely narrow, receiving recurrent nervure before end; abdomen dullish, with a sericeous surface, the tergites shining before the depression; hair at apex pale grayish brown.

California: Tub Spring, near Borego, San Diego County, March 21, 1935, 1 ♀ (Wilmatte P. Cockerell). Very near to *C. bakeri* Crawford, which Timberlake takes on *Phacelia distans* Benthams in May, but differs by the broader head, flagellum red beneath, more shining mesothorax, and much paler stigma.

### Panurgidae

#### *Calliopsis andreniformis* Smith

Colorado: White Rocks, Boulder Co., July 8, 1935, both sexes abundant at white *Petalostemon* flowers (Chas. Michener, T. D. A. Cockerell). These are *C. andreniformis*, not the western *C. rhodophilus* Ckll.

#### *Halictoides scintilla* (Cockerell)

California: Claremont (Baker). A re-examination of the type of *Diandrena scintilla* shows that it is related to *Halictoides viridescens* Crawford. The two species form a group, very distinct from typical *Halictoides*.

#### *Panurginus bakeri* Cockerell

Colorado: Aspen, alt. 8000 ft., July 24-27, 1919 (Lutz); Ward, alt. 8600 ft., July 7, 1922 (Gordon W. Strawbridge). Both males.

#### *Panurginus cressioniellus* Cockerell

Colorado: Longs Peak, alt. approx. 9000 ft., June 14, 1922, 1 ♂ (Lutz).

#### *Panurginus innuptus* (Cockerell)

Colorado: La Junta, alt. 4100 ft., Aug. 12, 1920, 1 ♂, 1 ♀ (Lutz).

#### *Panurginus porterae* Cockerell

Colorado: Jim Creek, near Boulder, alt. approx. 6400 ft., July-Aug. 1922, 7 ♀, 14 ♂, at *Rudbeckia laciniata* and also at light, one pair copulating at 7:15 A.M. (Lutz).

#### *Perdita albipennis hyalina* (Cresson)

Colorado: White Rocks, Boulder Co., one male at flowers of *Helianthus petiolaris*, July 8, 1935 (Chas. Michener). It differs from Cresson's description in having the front tibiae entirely black, and the tarsi dark, the small joints of the front pair reddened. In my key (Proc. Acad. Nat. Sci. Phila., 1896) it runs out at 21. Two females of *Perdita affinis* Cresson were also taken at the same time, on the same flowers.



## Anthophoridae

*Centris aterrima* Smith

Arizona: Tumacacori Mts., Aug. 3, 1931 (I. Wilson). Submitted by Chas. Michener. New to the United States.

*Anthophora neglecta* Timberlake and Cockerell, new species

Closely allied to *A. edwardsii* Cresson, but "genitalia quite different, and abdomen with no metallic color, and spurs of middle tibiae not curved at end as in *A. edwardsii*; hair of thorax above and first tergite varies to fulvous." (Timberlake.)

MALE (type).—About 12 mm. long, anterior wing 10.4; black, without metallic tints; hair of head, thorax, and first two tergites long and white; mandibles and antennae black, except that the scape is mainly cream-colored in front; eyes dark gray; clypeus convex, polished, cream-colored, except narrow lower margin, and broad black band on each side; other cream-colored marks are a narrow stripe along lower margin of supraclypeal area, arrowhead-shaped lateral marks (the concave upper end fimbriate), and labrum except the lower edge and large black spots at basal corners; third antennal joint long and slender, longer than the next two combined; some dusky hairs in region of ocelli; mesothorax and scutellum dull, the later with a median keel on anterior part; tegulae very dark brown; wings clear hyaline, nervures dark brown; basal nervure meeting nervulus; second cubital cell receiving recurrent nervure in middle; legs with white hair, rusty black on inner side of hind tibiae and tarsi; middle tarsi simple, but the claw-joint swollen; tergites obscurely brownish apically; third to fifth with scanty black hair; sides of sixth with shining white hair, and pale yellowish hair on each side of the narrow apical plate.

FEMALE.—Similar but more robust, without light markings on head or antennae; a slender keel from lower end of clypeus to middle ocellus, more sharply defined at upper end; sides of face, vertex, and thorax above with black hairs intermixed; lateral margins of abdomen fringed with white hair.

California: Tub Spring, Borego, both sexes at flowers of *Amsinckia douglasiana* A. DeCandolle, March 21, 1935 (W. P. Cockerell). I showed this to Mr. Timberlake, and found that he had already taken it, at Little Rock, California, March 1932, also at flowers of *A. douglasiana*. He had recognized it as new, with the diagnostic characters cited above, but he suggests that I should publish it.

The male *A. neglecta* is easily known from *A. edwardsii* by the shining cream-colored clypeus; in *A. edwardsii* it is dull and yellow. There are several females which are much alike, as follows:

- 1.—More robust; hair of mesothorax above entirely white, or with a little blackish anteriorly; eyes green; tegulae red. . . . . *porterae* Cockerell.  
Less robust; hair of mesothorax with a conspicuous admixture of black; tegulae dark brown or black. . . . . 2.
- 2.—Eyes black or dark gray. . . . . *neglecta* Timberlake and Cockerell.  
Eyes pea green. . . . . 3.

- 3.—Clypeus dull and rough, without a distinct median ridge. . . . *edwardsii* Cresson.  
Clypeus with a distinct median ridge. . . . . *simillima* Cresson.

**Diadasia afflicta** Cresson

New Mexico: Six miles east of Folsom, June 30, 1935, numerous females (J. D. Figgins). They were nesting in soft ground, and did not make any structures to protect entrance to nest. New to New Mexico.

**Melissodes hortivagans** Cockerell

Colorado: Boulder, July 27, 1922, 2 ♂, at pink geranium (Lutz). One has the fifth tergite with the hair practically all black; in the other there is a white band. New to Colorado.

**Melissodes hymenoxidis** Cockerell

Utah: Huntsville, July 26, 1920, 1 ♀, mostly on *Grindelia* (Lutz).

**Melissodes obliqua** (Say)

Colorado: Jim Creek, near Boulder, alt. 6400 ft., Aug. 2, 1922, 1 ♂, at *Cleome serrulatum* (Lutz).

**Melissodes obliqua expurgata** Cockerell

Utah: Ogden, Aug. 29–30, 1916, 1 ♂, asleep in *Helianthus* flowers, (Lutz); Provo, 4750 ft., July 29–Aug. 1, 1920, 2 ♂ (Lutz).

Wyoming: Green River, alt. 6100 ft., July 2, 1920, 1 ♂ (Lutz).

**Melectidae**

**Neolarra congregata helianthi**, new subspecies

MALE.—A little larger; head broader (diameter of face about 1120 microns, in *N. congregata* 880); eyes dark gray; abdomen darker red, with the white bands broader.

Colorado: White Rocks, Boulder County, July 8, 1935, on flower of *Helianthus petiolaris* Nuttall, 1 ♂ (Cockerell). Probably a distinct species, parasitic on the sunflower *Perdita*. *N. congregata* Crawford visits *Verbesina encelioides*.

**Neolarra pruinosa** Ashmead

At White Rocks, Colorado, July 8, 1935. Mr. Chas. Michener took two male *Neolarra* on flowers of *Psoralea tenuiflora* Pursh, in the immediate vicinity of the habitat of *Perdita opuntiae* Ckll., though *P. zebra* Cresson also occurred near by. One of these males has a light red abdomen and, except for the sexual characters, exactly matches *N.*

*pruinosa*, described and known from the female. The other has a dark abdomen, reddish only at extreme tip, covered with pale pubescence (forming white bands at ends of tergites), exactly as in *N. vittata* Ckll. However, it seems not to be *N. vittata*, although extremely similar, the head of *N. vittata* being considerably larger, with longer, pale green eyes (eyes pale bluish gray in Colorado insect), while the abdomen is less depressed. In Pan-Pacific Entomologist, 1929, p. 105, it is suggested that *N. vittata* may be the male of *N. pruinosa*, but this now seems not to be the case. The sexes of *N. congregata* do not differ in the color of the abdomen. The male with dark abdomen, from White Rocks, may be a form of *N. pruinosa*, or it may be a distinct species.

### Oxaeidae

#### *Protoxaea nigerrima arizonica*, new subspecies

FEMALE.—Fringe of fifth tergite thick and black, with a little white at extreme sides; antennae without red, but scape obscurely brown at apex. The hair of mesothorax is dense, like velvet, brown-black; occiput and cheeks posteriorly with long white hair; wings dark reddish fuliginous; maxillary palpi well developed.

Arizona: Tumacacori Mts., Aug. 31, 1931 (I. Wilson). Submitted by Chas. Michener, who has three specimens, and presents the holotype to the American Museum.

*Caupolicana yarrowi* Cresson was taken in the same mountains, Aug. 28.

### Megachilidae

#### *Formicapis neomexicana* (Cockerell)

Colorado: Aspen, alt. 8000 ft., July 24-27, 1919, 2 ♀ (Lutz).





## SOME NEW WESTERN BIBIONIDAE (DIPTERA)

BY MAURICE T. JAMES<sup>1</sup>

While attempting to determine a collection of *Bibio* several years ago, I found so many species that would not run through McAtee's keys, the only ones available, and which would not conform to any existing descriptions, that I came to the conclusion that many undescribed species occur in the Rocky Mountain region. That this should be so is not surprising, in view of the great development of this genus in past geological ages, and in view of the comparative isolation of some of the mountain regions of Colorado that are so favorable to the development of these insects. Further study, and the examination of additional material, has confirmed these conclusions.

In the present paper, nine species are described from Colorado, Kansas, and Utah. Because of the incompleteness of this work, keys are not presented herein, as was originally intended. Holotypes and allotypes have been deposited in The American Museum of Natural History; paratypes of all species may be found in the collection of the Colorado State College. For the loan of specimens, I am indebted to the University of Kansas, the Kansas State College, Utah State Agricultural College, and the University of Colorado; also to Mr. Curtis W. Sabrosky.

A character, used in the present descriptions, which has apparently been overlooked by previous workers, is the comparative length of the radio-medial cross-vein and that part of the radius-sector basad of that cross-vein. Other venational characters appear to be too uncertain, although the comparative strength of the anterior and posterior veins seems to be of value.

*Bibio alexanderi*, new species

Related to *B. fraternus* Loew, but the spurs on the anterior tibiae are unequal and the coloration of the wings in the two sexes is the same; the female runs to *rufithorax* in McAtee's key, but differs in having yellow legs; the male runs to *xanthopus*.

FEMALE.—Head, including the appendages, black; head yellow-pilose; eyes with short, sparse, yellow pile; palpi and antennae black-pilose. Thorax reddish yellow; the pleura with a considerable but variable amount of black; pronotum mostly

<sup>1</sup> Colorado State College.

black; scutellum, metanotum, and abdomen black; body pale-pilose. Legs yellow, mostly with soft yellow pile; the tibiae sometimes slightly darkened apically; the tarsal segments blackened apically; tibiae and tarsi with black stubby pile. Inner spurs of anterior tibiae not quite one-half as long as the outer ones. Posterior femora clavate, their tibiae cylindrical; posterior basitarsi short, about one and one-half times as long as the second tarsal segment. Wings dusky, the clouding somewhat deeper along the costal margin; veins brown; stigma distinct, brown. Cross-vein r-m about equal in length to the basal part of the radius-sector. The veins of the posterior part of the wing almost as heavy as those near the costal margin; cross-vein m-cu faint. Length, 6 mm.

MALE.—Thorax, coxae, and trochanters entirely black; pile of eyes moderately long, mostly pale; considerable bushy black pile on the lower part of the occiput; pile of the body longer and bushier than in the female; halteres black. Otherwise as in the female.

TYPES.—Holotype, female, Boulder Creek bottoms near Valmont, Colo., April 24, 1934 (E. Gordon Alexander). Allotopotype, same data. Paratopotypes, 3 females, 1 male, same data.

#### *Bibio painteri*; new species

Related to *alexanderi*; it differs as follows. The dorsum of the thorax, in the female, is extensively marked with black; the extent of this black is variable, and may cover the larger part of the dorsum. The pile of the tibiae is pale in both sexes and similar to that of the femora. In the male, the posterior tibiae, as well as the femora, are clavate; the eyes are black-haired, and there is usually a considerable amount of pale pile on the lower part of the occiput.

TYPES.—Holotype, female, allotype, male (on the same pin), Manhattan, Kansas, April 19, 1932 (R. H. Painter). Paratypes: 13 pairs, same data, in copulation; 1 male, 1 female, same data; 10 males, 4 females, Manhattan, Kansas, April 14 to 27 (C. W. Sabrosky).

#### *Bibio atripilosus*, new species

Related to *xanthopus*, to which it runs in McAtee's key; but it is quite a different species.

MALE.—Head, thorax, and abdomen wholly black; head wholly black-pilose; pile of eyes dense, moderately long, black; dorsum of thorax conspicuously yellow-pilose, with a little gray pile laterally; pleura whitish- to gray-pilose. Abdomen with conspicuous tufts of black hair on the first segment, laterally; the next segments black- to gray-pilose, this pile gradually becoming pale at the apex of the abdomen. Inner spur of the anterior tibiae one-third the length of the outer one. Hind femora and tibiae clavate, rather elongate, the basitarsi not enlarged, about one and one-half times as large as the second tarsal segment. Coxae and trochanters black; femora black, yellow at the apex, the black gradually merging into yellow; hind femora usually pale on about the apical third; tibiae yellow, the posterior ones blackish above; anterior tibiae rusty yellow; tarsi yellow, the segments after the first, darkened, at least apically. Wings grayish-hyaline; stigma and strong veins brown, the other veins yellow; the veins of the posterior part of the wing not much paler than those of the anterior part; cross-vein r-m almost as long as the basal part of vein R<sub>5</sub>. Length, 7 mm.

Types.—Holotype, male, Boulder, Colo., May 5, 1934 (James). Paratopotypes: 5 males, same data; 1 male, Boulder, Colo., April 17, 1934 (James); 1 male, Boulder, Colo., May 16, 1933 (James).

*Bibio monstri*, new species

Related to *labradorensis* Johnson, but readily distinguished from that species by the black femora and the black pile of the thorax.

MALE.—Head, with appendages, thorax, and abdomen, black. Head wholly black-pilose; eyes with copious black pile. Thorax with moderately sparse but long black pile dorsally and a heavy tuft of the same color on each squama; pile otherwise gray. First abdominal segment with heavy, close, black pile; pile otherwise looser, gray to white, and somewhat longer. Coxae, trochanters, and femora black, black-pilose, the posterior ones partly pale-pilose; tibiae and basitarsi yellow, darkened

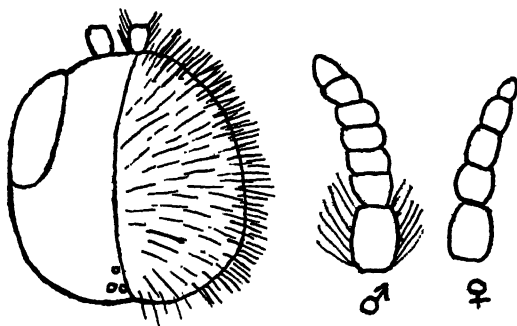


Fig. 1. *Bibio monstri*, new species. Gynandromorph. Head, dorsal view; antennae.

apically; the other tarsal segments brown to black; pile of tibiae and tarsi variably gray to yellow. Inner spurs of anterior tibiae very small. Posterior tibiae and femora elongate, clavate, the tibiae being the thicker; posterior basitarsi enlarged, as thick as the apices of the femora; the three following segments more or less globular. Wings pale yellow, almost white, hyaline; the costa brown, the other anterior veins yellow; the remaining veins barely discernible from the membrane; stigma obsolete, represented only by a pale yellow clouding along the apex of vein  $R_1$ ; cross-vein  $r-m$  about one-half the length of the basal part of  $R_5$ . Length, 6 mm.

Types.—Holotype, male, Trail Ridge Road, Rocky Mountain National Park, Colo., 12,200 ft., Aug. 25, 1933 (M. T. James). Paratypes: male, same data; 9 males, Estes Park, Aug., 1892 (F. H. Snow).

A peculiar gynandromorph belonging to this species has the head half male and half female; otherwise, it seems to be a normal male. The bizarre appearance produced by the large, long-pilose, eye on the one side, and the small, bare one on the other, is shown by the accompanying illustration. The difference in the antennae will also be noted.



*Bibio pingreensis*, new species

Related to *inaequalis* Loew, but the posterior basitarsi are not so noticeably enlarged and the legs are differently colored; it is more robust than *longipes*, and the structure of the posterior tarsi is different.

**MALE.**—Head, with appendages, thorax, and abdomen black. Head wholly black-haired, the eyes with copious black hair. Thorax, abdomen, and legs with long yellowish pile; a little gray pile on the mesopleura; some short black pile on the tibiae and tarsi. Coxae, trochanters, femora, and anterior tibiae black; the spurs on the anterior tibiae yellow, the inner spur one-third the length of the outer one; posterior femora strongly clavate, the constricted basal part yellowish; middle tibiae brown; posterior tibiae yellowish to brown; tarsi brown, the basitarsi yellowish to brown. Posterior basitarsi slightly enlarged, but cylindrical, rather than globular, as in the related species. Wings whitish or slightly grayish hyaline; the strong veins brown; the posterior ones barely discernible from the membrane; cross-vein r-m about one-half as long as the basal section of vein  $R_s$ . Length, 7–8 mm.

**TYPES.**—Holotype, male, Mummy Pass, Alpine zone, Pingree Park, Colo., Aug. 18, 1932 (Leonard Sweetman). Paratopotypes, 4 males, same data.

*Bibio macateei*, new species

This is apparently the species which McAtee refers, with a query, to *humeralis* Walker. Walker's species is unidentifiable from the description and is from a far-distant locality; therefore, in view of the fact that I have before me a good series of specimens, including both sexes, it seems better to describe the species as new rather than to retain a very questionable determination.

**FEMALE.**—Head, with appendages, thorax, and abdomen black; the humeri, the complete V-shaped anterior margin of the mesonotum, and several irregular and variable splotches on the pleura, yellowish to brown. Head with short black pile on the vertex, front, and antennae; sometimes also some paler pile on the front; that of the lower occiput longer, bushy, and pale. Body pale-pilose; some short, stubby, grayish pile on the legs. Coxae and trochanters black, the anterior ones reddish outside; femora, tibiae, and tarsi bright yellow, the three apical tarsal segments darkened, the other two brownish apically; the inner spur of the anterior tibia one-third the length of the outer one. Posterior femora clavate. Wings uniformly yellow; stigma and strong veins brown; the posterior veins concolorous with the membrane and barely discernible; cross-vein r-m as long as the basal section of vein  $R_s$ . Length, 8–9 mm.

**MALE.**—Thorax entirely black, except for the very narrow anterior margins of the mesonotum, which are yellow, the yellow, however, merging into black medially; anterior coxae and trochanters black. Pile of entire body long and bushy; some black pile on the under side of the head and behind the ocellar triangle; that of the eyes dense, black; otherwise, except the short black pile of the tibiae and tarsi, whitish or yellowish. Posterior tibiae as well as the femora clavate; the basitarsi slightly enlarged, but cylindrical. Otherwise as in the female.

**TYPES.**—Holotype, female, Trail Ridge Road, Rocky Mountain National Park, 11,000 ft., Aug. 25, 1933 (M. T. and H. B. James). Allotype, same data. Paratypes: 2 females, 9 males, same data; 2 males, Brainerd Lake, Colo., Aug. 28 (T. D. A. Cockerell).

*Bibio similis*, new species

Related to *B. albipennis*, of which it may be a variety or subspecies, but readily distinguished by the long cross-vein r-m, which is almost as long as the basal section of vein R<sub>5</sub>.

**MALE**.—Body entirely black, mostly with bushy pale yellow pile; a few long gray hairs on the abdomen and on the coxae; lower part of the occiput with bushy black pile; pile of eyes long, rather dense, and black; tibiae and tarsi with short black and pale hair intermixed, mostly erect. Posterior tibiae and tarsi clavate; their basitarsi not enlarged, about one and one-half times as long as the second tarsal segment. Claws of anterior tibiae reddish; the inner one one-third the length of the outer one; anterior basitarsi narrowly yellow at the base. Wings whitish hyaline; veins and stigma black, the posterior veins but slightly weaker than the anterior ones; cross-vein r-m about as long as the basal section of vein R<sub>5</sub>. Length, 8 mm.

**TYPES**.—Holotype, male, Boulder, Colo., May 5, 1934 (M. T. James). Paratypes: male, Rifle, Colo., May 5, 1905; 2 males, Fort Duchesne, Utah, May 17, 1933 (F. K. Stoffers).

Five species of *Bibio* known to me have the radio-medial cross-vein very short, this vein being not more than one-third (usually one-fourth or less) the length of the basal section of the radius sector. The following table will serve to separate these species.

- |   |                             |
|---|-----------------------------|
| 1.—Legs wholly black or dark brown.....   | 2.                          |
| At least the tibiae yellow; posterior basitarsi but slightly longer than the second tarsal segment..... | 4.                          |
| 2.—Posterior basitarsi twice as long as the second tarsal segment.....                                  | 3.                          |
| Posterior basitarsi not more than one and one-half times as long as the second tarsal segment.....      | <i>tenuipes</i> Coquillett. |
| 3.—Wings milky white.....   | <i>albipennis</i> Say.      |
| Wings dusky.....  | <i>afer</i> McAtee.         |
| 4.—Femora black in male, yellow in female; thorax and abdomen mostly black-pilose.....                  | <i>curtipes</i> , n.sp.     |
| Femora yellow in both sexes; abdomen at most gray-pilose.....   | <i>kansensis</i> , n.sp.    |

*Bibio afer* McAtee

A series of specimens, Douglas Co., Kansas, May 11, 1931 (Beamer), has been referred to this species; they have the short cross-vein r-m, which McAtee does not mention in his description.

*Bibio curtipes*, new species

Related to *tenuipes* Coquillett, but the legs are extensively yellow and the vestiture of the body mostly black.

**FEMALE**.—Head, with appendages, thorax, and abdomen, wholly black; pile of head black; that of thorax black, intermixed with white; that of abdomen black on the disc, both dorsally and ventrally, a little whitish laterally. Legs yellow, short, the segments thick; the coxae slightly darkened, the apical two or three tarsal seg-

ments moderately so; pile very largely black. Halteres black. Inner claw of anterior tibiae about one-half the length of the outer one. Posterior femora clavate, the tibiae not so. Posterior basitarsi barely longer than the second tarsal segment. Wings slightly infumated; the anterior veins blackish, the posterior ones yellowish, but distinctly darker than the membrane; stigma distinct, black. Cross-vein r-m one-fourth the length of the basal part of vein  $R_s$ . Length, 6-7 mm.

**MALE.**—Eyes with moderately long and moderately dense black pile. Coxae, trochanters, and femora black; the tibiae and tarsi brownish yellow, the latter more darkened apically. The pile of the body may be entirely black, or there may be a little pale pile on the dorsum of the thorax and on the abdomen laterally. Otherwise as in the female.

**TYPES.**—Holotype, female, Boulder, Colo., May 5, 1934 (M. T. James). Allotype, same data. Paratypes: 2 males, same data; 2 males, "Colo. 4421," Walsenburg, Colo., May 16, 1928, sweeping wheat fields (S. C. McCampbell); 1 male, Bothwell, Utah, May 8, 1931, on *Norta altissima* (G. F. Knowlton).

### ***Bibio kansensis*, new species**

Similar to *fraternus* Loew, but the spurs of the anterior tibiae are unequal and the venation is different; it may be distinguished from other species of *Bibio* (except the female of *curtipes*) by the short cross-vein r-m and the wholly pale legs.

**FEMALE.**—Black, the pile of the body mostly grayish; legs short, thick, a somewhat obscure yellow in color, the coxae and trochanters darkened, the pile of the legs grayish to black, that of the tibiae stubby; the inner spur of the anterior tibiae not more than one-fourth the length of the outer one; posterior basitarsi flattened, barely longer than the second tarsal segment. Wings dusky hyaline; veins brown, heavier near the costa; stigma brown; cross-vein r-m one-third to one-fourth the length of the basal part of the radius sector. Length, 5-6 mm.

**MALE.**—Similar to the female; the pile of the body tends to be longer and darker, and the legs are slightly darkened.

**TYPES.**—Holotype, female, Kirwin, Kansas, May 9. Allotype, same data. Paratypes: about one hundred and fifty specimens, from the collection of the Kansas State College, same data as the above, and no locality, April 13.





# AMERICAN MUSEUM NOVITATES<sup>1</sup>

Number 833

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

March 26, 1936

## A NEW *DIOPSIS* FROM INDIA, WITH NOTES ON OTHERS (DIPTERA)

By C. H. CURRAN

The species described below was forwarded for determination by Dr. R. Senior White, with the statement that it differed from the species with which he was familiar. Owing to the similar wing markings of many of the Oriental Diopsidae the identification of the species is difficult. Unfortunately, the collections before me are so small that the preparation of a key to the species is not possible, but notes are given on some closely related forms.

### *Diopsis whitei*, new species

Related to *ferruginea* but shining blackish, the mesonotum brown pollinose except on the broad sides. Length, 5 to 7 mm. Width of head, male, 9 mm., female, 5.5 mm. The female is only 5 mm. in length.

**MALE.**—Head shining reddish; eye-stalks black ventrally and on the apex except in front; beyond the middle with tubercle and strong spine; on their upper surface with many low tubercles and with long sparse hair; in front with a partial row of sparse hairs. Antennae reddish, the apex of the third segment with brown tinge; arista brownish. Front with three or four irregular longitudinal furrows on each side, the ocellar triangle conspicuously raised. Middle of face rather strongly produced, the oral margin without teeth. Hair rather long, black. Palpi and clypeus reddish.

Thorax shining dark brown, the mesonotum with brownish pollen, leaving the sides very broadly shining behind the humeri. Hair long and yellowish. Scutellum pollinose, the spines very long and black, bearing long pale hair. Posterior half of the pleura above, metanotum and metasternum pale pollinose.

Legs reddish; tibiae brown, the front pair black, the middle tibiae with the apex reddish; first segment of the front tarsi strongly broadened, reddish on the basal half, black apically; second segment of front tarsi black, the apical three reddish yellow; middle tarsi brown with the basal one or two segments reddish; posterior tarsi brown with reddish base. Anterior femora not sharply constricted at the apex, the tubercle on their tibiae low and round; middle and posterior femora somewhat brownish apically.

Wings cinereous hyaline, with four brown bands, the one on the apex of the wing narrow; a wide, somewhat irregular brown band extends entirely across the middle of the wing, a somewhat wider one extends across the apical fourth, while a narrow, paler band extends backward from the third vein just beyond the basal third of the wing. Squamae and halteres yellow.

Abdomen shining brownish black; sides of the first segment and basal half of the

second broadly reddish, the third with a large reddish triangular spot on each side at the base, covered with white pollen, the second segment very thinly pollinose on the apical three-fifths; sixth segment pale pollinose.

**FEMALE.**—The width of the eye-stalks is only about equal to the length of the body, the anterior femur is less distinctly narrowed and the tubercle on the front tibia is very weak.

**TYPES.**—Holotype, male, and allotype, female, Saranda, Ch. Nagpur, India, May 2, 1935 (R. Senior White).

#### ***Diopsis indica* Westwood**

This species is common in India and is represented in the material before me by a series of thirteen specimens forwarded by Dr. T. Bainbrigge Fletcher.

Five males and five females, Gokteik, Upper Burma, March 31, 1913 (Y. R. Rao); one female, Assam, May, 1913, and two females, Khasi Hill, Assam, March 17, 1907.

#### ***Diopsis ferruginea* Roeder**

Four males and five females, Mergui, India, December 21–January 11, 1922 (Sharma).

This species is very close to *dalmanni* Wiedemann but differs in having the anterior femora much more strongly constricted at the apex and a stronger, acute tubercle on the base of the tibia. The upper part of the pleura posteriorly is less distinctly pollinose and the preapical brown band on the wing is distinctly wider.

#### ***Diopsis dalmanni* Wiedemann**

Male, Anai Kloof, west coast of Sumatra, 1926.

The first segment of the front tarsus in this and the preceding species is considerably elongated and broadened. The thorax is shining reddish ferruginous.







## THREE NEW SPECIES OF *MEROMACRUS* (DIPTERA, SYRPHIDAE)

By C. H. CURRAN

The strictly American genus *Meromacrus* Rondani is confined to the tropics, with the exception of one species occurring in the southeastern United States. Up to the present time sixteen species have been definitely assigned to the genus. It is possible that some other described forms belong here but this cannot be determined from the descriptions. The members of the genus are moderately large, brightly colored flies, most readily distinguished from *Eristalis* Latreille by the presence of yellowish tomentose markings on the thorax.

The types of the new species are in The American Museum of Natural History. The following key includes only those species that are represented in the Museum collection.

### TABLE OF SPECIES

- 1.—Abdomen with pale tomentose spots or fasciae beyond the first segment. . . . . 2.  
     Abdomen without pale tomentose markings beyond the first segment. . . . . 12.
- 2.—With a large, equilateral yellow tomentose triangle immediately in front of the scutellum. . . . . *millesoides* Bigot.  
     Prescutellar tomentose markings transverse, not forming a large triangle. . . . . 3.
- 3.—No pale markings immediately in front of the scutellum. . . . . *bruneri*, n. sp.  
     A band of pale hair or tomentum in front of the scutellum. . . . . 4.
- 4.—Costal border of the wing with very broad, sharply defined yellowish or brown border. . . . . 6.  
     Costal border of the wing broadly darkened but never greatly contrasting with the remainder of the wing; mesonotal suture never with yellow tomentum on inner half. . . . . 5.
- 5.—Mesonotum with four distinct cinereous vittae, the median pair closely approximate; second and third abdominal segments mostly tawny, and yellow pilose.  
     *potens* Curran.  
     Mesonotum almost unicolorous except for the yellow tomentose spots; second and third segments mostly black pilose, the third with broad, yellow tomentose basal fascia. . . . . *cinctus* Drury.
- 6.—An oblique, curved yellow stripe extends from the notopleura to the anterior margin of the mesonotum inside the humeri. . . . . *simplex* Schiner.  
     No continuous stripe from the notopleura to the inner ends of the humeri. . . . . 7.
- 7.—Pale fasciae on the third and fourth abdominal segments broadly interrupted in the middle. . . . . 8.

- Pale fasciae entire or only obscurely interrupted. . . . . *zonatus* Loew.
- 8.—Third antennal segment decidedly longer than wide. . . . . 9.  
Third antennal segment wider than long. . . . . *ruficrus* Wiedemann.
- 9.—Tomentose markings on the mesonotal sutures entire. . . . . 10.  
Tomentose markings on the mesonotal sutures divided to form two spots on either side. . . . . *decorus* Loew.
- 10.—Posterior femora black-haired above on the apical third. . . . . 11.  
Posterior femora wholly reddish yellow pilose except for part of the stout setulae below on the apical third. . . . . *flukei*, n. sp.
- 11.—Wings yellowish in front on the basal half. . . . . *acutus* Fabricius.  
Wings brown in front, the costal cell paler. . . . . *pratorum* Fabricius.<sup>1</sup>
- 12.—Wings deep black on the whole length, the costal cell not distinctly paler; first whole abdominal segment without conspicuous yellow tomentum. . . . . *niger* Sack.  
Wings with at least the costal cell luteous or subhyaline; first abdominal segment with a pair of contiguous, rectangular yellow tomentose spots, or yellow pilose. . . . . 13.
- 13.—Wings yellowish anteriorly on the basal half. . . . . *fucatus* Hull.  
Wings with only the costal cell luteous. . . . . *anna*, n. sp.

### *Meromacrus bruneri*, new species

Thorax opaque black, with a pair of yellow tomentose triangles in front; abdomen shining black. Length, 16 mm.

**FEMALE.**—Head black in ground color, the sides of the face broadly and the narrow posterior orbits whitish pollinose. Front dull black, black-haired, the sides narrowly brownish yellow pollinose on more than the lower half. Hair of the posterior orbits white except above and below. Cheeks and face shining black, the face with thin white hair on the pollinose portion; face in profile perpendicular below, rather deeply concave on the upper half, the antennal prominence shining. Antennae black, the third segment transverse.

Thorax opaque black, clothed with short black hair except for a pair of subtriangular yellow tomentose spots in front. Scutellum shining brown, with a trace of cinereous pollen.

Legs blackish, black-haired; posterior tibiae with a median tubercular swelling on the under surface.

Wings with brown tinge, broadly brown in front. Squamae brown, with reddish brown fringe. Halteres brown.

Abdomen shining bluish black, black-haired; second segment with a broad median fascia of brownish hair; third segment with a very narrow basal fascia of yellowish hair and lateral tufts of pale yellow pile. Sternites with long black hair.

**HOLOTYPE.**—Female, La Salle School Collection, E. E. A. Cuba, No. 10393, received from Dr. Bruner through Dr. C. L. Fluke.

<sup>1</sup> This is the same species which I described as *panamensis* and its range extends into Brazil. In his original description Fabricius states that the posterior femora are 'unidentate,' a character not found in any species of *Meromacrus* but suggestive of *Spilomyia* or a related genus. In other respects the description agrees with this form and also with Wiedemann's interpretation of the species. The West Indian forms recorded by Williston and myself as *pratorum* represent a distinct species which is herein described under the name *flukei*.

*Meromacrus flukeyi*, new species

Related to *decorus* Loew but at once distinguished by having the sutural tomentose stripe entire and not broken into a notopleural and sutural spot, much paler facial pile and the abdominal spots narrowed laterally. Length, 10 to 13 mm.

**MALE.**—Front brownish red, the sides white pollinose and thickly whitish pilose; vertical triangle black, pale pollinose and pilose in front of the ocelli; vertex black; occiput whitish pollinose and very pale yellow tomentose, the pile of the vertex yellow. Cheeks and middle of face brownish yellow, the sides of the face broadly whitish pollinose and densely pale yellowish or almost whitish pilose. Face slightly retreating, very gently concave above. Antennae brownish yellow; third segment oval, one-half longer than wide; arista yellow.

Thorax reddish brown, the mesonotum dull black except on the broad sides, the pleura with a broad black band across the middle, this latter mostly covered by pale yellow tomentum. Mesonotum with a pair of yellow tomentose, triangular spots in front and with the suture broadly (broadly interrupted in the middle) yellow tomentose, the usual prescutellar band of tomentum also present. Scutellum reddish brown or brownish red, with very short black hair, the margin with some long pale hairs except in the middle.

Legs bright orange, the hair wholly yellow except for some black setulae on the ventral surface of the femora; coxae white pollinose.

Wings hyaline, brownish yellow in front, more brown on the apical third. Squamae with brown border and yellowish fringe. Halteres reddish.

Abdomen reddish with the upper surface mostly dull black, sometimes black, with yellow tomentose markings on a reddish or yellowish ground. First segment with a pair of large, moderately separated pale yellow tomentose spots, their outer ends contiguous with a patch of longer white tomentum or pile on the sides of the second segment in front; second segment with a broadly interrupted median shining fascia, the outer ends broadened and reaching the base of the segment and extending narrowly to the posterior border. Third and fourth segments each with a broadly interrupted basal band of yellow tomentum, the spots formed widest near their inner ends and distinctly narrowed laterally. Hair coarse, sparse and black dorsally, fine, abundant and pale yellow on the sides, long and whitish on the venter. Genitalia brownish yellow, with rather golden or brownish yellow appressed hair.

**FEMALE.**—Sides of the front broadly yellow tomentose or densely pilose to the level of the anterior ocellus, the pale pile usually replacing the black median pile for some distance in front of the ocelli but the brown median vitta is distinct; facial pile yellow but still much paler than in *decorus*. One female has the abdomen considerably reddish while the other has it black; apical segments dull reddish brown, with black hair; hair of venter shorter and pale yellowish.

**TYPES.**—Holotype, male, and allotype, female, St. Vincent, West Indies (Williston Collection). Paratype, female, St. Thomas, Virgin Islands, November 22, 1925 (F. E. Lutz).

This species has been recorded by Williston from St. Vincent as *pratorum* Fabricius and by myself as the same species from St. Thomas. I have seen *pratorum* from several localities in South America and, follow-



# AMERICAN MUSEUM NOVITATES

Number 835

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

March 28, 1936

## ON *DECAPTERUS SCOMBRINUS* (VALENCIENNES)

By J. T. NICHOLS

After examining various type material in the Paris Museum in 1909, I reached the conclusion that *Decapterus macarellus*, the terminal member of this genus, that is the one farthest removed from the primitive caranx stem, was cosmopolitan in warm seas, perhaps differentiable into geographic races as *macarellus* (North Atlantic), *sanctae-helenae* (South Atlantic), *hypodus* (west coast of America), *pinnulatus* (Central Pacific), *muroadsi* (Japanese Seas), and *macrosoma* (East Indies). It was more slender than the others, longer bodied, with teeth absent or scarcely evident and scutes fewer and confined to the posterior part of the lateral line.

In 1923 I listed a specimen of *Decapterus* from Mangareva as *D. macarellus pinnulatus* (Amer. Mus. Novitates, No. 94, p. 3). Two others recently collected by Templeton Crocker from Hiva Oa Island, Marquesas, and Albemarle Island, Galapagos, are very like it, such slight differences as they show being assignable to size and individual variation; but on critical comparison with specimens of *pinnulatus* from its type locality, the Hawaiian Islands, collected by David Starr Jordan in 1921, they are clearly specifically distinct from that form. Though within the *macarellus* group, they are somewhat deeper than *macarellus*, with scutes occupying most of the straight part of lateral line in large specimens. A more tangible difference is in the undifferentiated scales of the lateral line preceding the scutes, 60 to 80 in number versus 90 to 105 in *macarellus* races. I refer them without hesitation to *Decapterus hypodus* Gill, 1862 (Proc. Acad. Phila., p. 261), Cape San Lucas.

However, Valenciennes, 1846 ('Voyage "Venus,"' p. 332, Pl. VII, fig. 1) described a *Decapterus* from the Galapagos as *Caranx scombrinus*, which must be considered. Jordan and Evermann, 1896 (Bull. U. S. Nat. Mus., XLVII, pt. 1, p. 908), thought this, without seeing it, close to *Decapterus punctatus*, but when I examined the type in Paris, an unsatisfactory stuffed specimen, it seemed to me close to if not identical with *macarellus*. Furthermore, my memoranda at the time, of anal (about 27—1) and scutes (about 29), made without prejudice or reference to the type description (with which they disagree), agree with the specimens

under consideration. Comparing Valenciennes' figure of *Caranx scombrinus* with this material convinces me that this was the fish he had. Hence, I so identify it, and make *Decapterus hypodus* Gill a synonym of *Caranx scombrinus* Valenciennes.

On the basis of one unsatisfactory specimen of *Decapterus muroadsi* from Japan, to hand for comparison, that form is close to *scombrinus* (as recognized above) rather than to *pinnulatus* or *macarellus*. At present I recognize forms of the *Decapterus macarellus* group according to the following key and synonymy.

This paper was prepared prior to the receipt of a review of the genus *Decapterus* by Norman (1935, Ann. Mag. Nat. Hist., (10) XVI, pp. 252-264, Figs. 1-4), with which, fortunately, it has been possible to correlate it.

#### DECAPTERUS Bleeker

- 1.—Depth in length to notch of caudal fin, 4.4 to 5; 47 to 56 scales followed by 32 to 40 scutes; teeth small but evident. . . . . (other species).  
 Depth in above length about 4; 26 small scutes on posterior half of lateral line.  
 Dorsal with 29 soft rays. New Zealand. . . . . *koheru*.  
 Depth in above length, 5 to 6.5; 60 to 105 scales followed by 20 to 30 scutes; teeth smaller, little evident or absent. *macarellus* group. . . . . 2.
- 2.—Depth in standard length, less than 5.5; scutes occupying posterior 0.5 to 0.8 straight part of lateral line; less than 90 scales followed by 26 to 35 scutes. . . 3.  
 Depth in standard length less than 5.5; about 100 scales followed by 27 or 28 scutes. . . . . *lajang*.  
 Depth in standard length, 5.5 or more; scutes occupying about posterior 0.5 straight part of lateral line (*macarellus*). . . . . 4.
- 3.—A scaleless supra-occipital triangle on top of head (up to 250 mm. standard length). Dorsal 29 to 31—1; anal, 26 to 29—1; scutes 26 to 30 (specimens examined). . . . . *scombrinus*.  
 Supra-occipital triangle mostly scaled (at 150 mm. standard length). Dorsal 31 to 35—1; anal, 26 to 30—1; scutes 26 to 33 (Wakiya, 1924, and synonyms).  
*muroadsi*.  
 Dorsal soft rays, 35—1; anal, 30—1; scutes about 35 (type description).  
*sanctae-helenae*.
- 4.—<sup>1</sup>Teeth obsolete; scutes 25. North Atlantic. . . . . *macarellus*.  
 A few very small teeth on palatines and tongue; scutes 25 to 27. Pacific.  
*pinnulatus*.  
 Teeth in lower jaw, on vomer and sometimes palatines; scutes 28 to 30. East Indies. . . . . *macrosoma*.  
 Teeth in lower jaw, on vomer and palatines; scutes 25 to 28; depth 5.3 to 6. Australia. . . . . *leptosomus*.

<sup>1</sup> I find tooth characters unsatisfactory in this genus, and the geographic races of *macarellus* little more than nominal until material from their respective localities has been compared. There is some doubt whether *leptosomus* belongs here.

*Decapterus scombrinus* (Valenciennes)*Caranx scombrinus* VALENCIENNES, 1846, 'Voyage "Venus,"' p. 332, Pl. VII, fig.

## 1. Galapagos Islands.

*Decapterus hypodus* GILL, 1862, Proc. Acad. Phila., p. 261. Cape San Lucas (dorsal soft rays, 31—1, misprinted 21—1 in Bull. XLVII, U. S. Nat. Mus.).*Decapterus macarellus pinnulatus*, NICHOLS, 1923, Amer. Mus. Novitates, No. 94, p. 3. Mangareva. Not *Caranx pinnulatus* Eydoux and Souleyet.*Decapterus kiliche*, NORMAN, 1935, Ann. Mag. Nat. Hist., (10) XVI, p. 260, Fig.

## 3. Muscat; not of Cuvier and Valenciennes (type examined, 1909).

HABITAT.—Eastern Pacific, or Indo-Pacific.

Depth in length to base of caudal, 4.5 (at 355 mm.) to 5.3 (at 85 mm.); head, 3.5 to 3.8. Eye in head, 4 to 4.5; pectoral, 1.2 (at 355 mm.), 1.3 (at 235 mm.), 1.4 (at 213 mm.), 1.6 (at 85 mm.). Dorsal soft rays, 29 to 31—1; anal, 26 to 29—1. Scales 61 to 77 + 26 to 30 more or less well-developed scutes occupying a little more than half (at 85 mm.) to 0.8 of the straight part of lateral line (at 235 to 355 mm.), which is contained 1.1 to 1.4 times in the curved part. Scales on top of head little developed at 85 mm., leaving a scaleless supra-occipital triangle at from 213 to 235 mm., which is invaded and covered by scales leaving only its backward directed apex scaleless at 355 mm.

More or less silvery, darker on the back, the dark blotch at margin of opercle not conspicuous, lining of gill-cavity dusky or blackish at 213 mm. and larger.

I find no significant differences in *Decapterus kiliche* as described and figured by Norman and believe he must have had a fish at least specifically identical.

*Decapterus muroadsi* (Temminck and Schlegel)*Caranx muroadsi* TEMMINCK AND SCHLEGEL, 1847, 'Fauna Japonica,' Pl. LVIII, fig. 1. Japan.*Decapterus macrosoma* and *lajang*, WAKIYA, 1924, Ann. Carn. Mus., XV, Pls. XVI, fig. 2, XVII, fig. 1. Japan.

HABITAT.—Japanese Seas.

Depth in length to base of caudal, 5.1 to 5.2 (at 133 mm.). Dorsal soft rays, 33—1; anal, 28—1. Scales about 80 + 26 to 28 more or less well-developed scutes occupying 0.5 to 0.7 of the straight part of lateral line.

Bluish on back to yellowish along mid-line of side, abruptly whitish below; a small black opercular spot.

When *sanctae-helenae* is better known, this will very likely be found to be a distinguishable race of same.



*Decapterus lajang* Bleeker

*Decapterus lajang* BLEEKER, 1855, Nat. Tijd. Ned. Ind., VIII, p. 302. Ternate.

*Decapterus lajang*, NORMAN, 1935, Ann. Mag. Nat. Hist., (10) XVI, p. 261. Durban.

HABITAT.—East Indies and Indian Ocean.

Depth, 5 to 5.3; head, 3.8 to 3.9. Eye in head, 3.7 to more than 4 (specimens of 185 to 190 mm. total length). Dorsal soft rays, 34 or 35; anal, 28 to 31. Scutes, 27 or 28.

This may be conspecific with *sanctae-helenae*, *muroadsi*, or both.

*Decapterus sanctae-helenae* (Cuvier and Valenciennes)

*Caranx sanctae-helenae* CUVIER AND VALENCIENNES, 1833, 'Hist. Nat. Poiss.,' IX, p. 37. St. Helena.

?*Decapterus muroadsi*, BARNARD, 1927, Ann. South. Afr. Mus., XXI, p. 536. Delagoa Bay.

HABITAT.—St. Helena. The relationship of the fauna of St. Helena to that of South Africa is such that a *Decapterus* occurring in the former would almost surely be present in the latter locality.

When in the Paris Museum in 1909, I made notes on the types of *Caranx macarellus* and *jacobaeus* Cuvier and Valenciennes, *scombrinus* Valenciennes, and *pinnulatus* Eydoux and Souleyet, but did not find the type of *sanctae-helenae*, concerning which form there is some uncertainty. I believe it advisable to use *macarellus* as a species name in spite of page priority of *sanctae-helenae*, in case *sanctae-helenae* proves to be conspecific with *macarellus*; and it now seems unlikely that it is so. Steindachner and Döderlein, 1885 (Denkschr. Wien, XLIX, p. 185), synonymize *muroadsi* with *sanctae-helenae*, and *muroadsi* is specifically distinct from *macarellus*, probably closer to *scombrinus*. They mention St. Helena material, presumably *sanctae-helenae*, as well as Japanese material of *muroadsi*, give an excellent figure of the latter, and would be expected to have recognized the two as distinct if they had not been very close. However, the characters they give as diagnostic for their comprehensive *sanctae-helenae*, pertain to the whole *macarellus* group including not only *muroadsi* but *scombrinus*, and *macarellus* races as well, distinguishing these from other members of the genus *Decapterus*; and it may be noted that prior to critical study and comparison of recently collected specimens of *scombrinus* I was of the opinion that this whole group was conspecific.

If Norman has not confused more than one form in material he assigns to *sanctae-helenae*, it varies in characters I have otherwise found

dependable in this group. His figure of a St. Helena specimen is very like *muroadsi*.

***Decapterus macarellus* (Cuvier and Valenciennes)**

*Caranx macarellus* CUVIER AND VALENCIENNES, 1833, 'Hist. Nat. Poiss.,' IX, p. 40. Martinique.

HABITAT.—Cosmopolitan in warm seas.

Depth in length to base of caudal, 5.0 to 6.5. Dorsal soft rays, 26 to 34—1; anal, 27 to 30—1. Scales, 90 to 104 + 25 to 30 more or less well-developed scutes occupying about the posterior half of the lateral line.

Bluish silvery above, paler below. A black spot at the upper edge of the opercle. Base of pectoral dusky.

***Decapterus macarellus macarellus* (Cuvier and Valenciennes)**

*Caranx macarellus* CUVIER AND VALENCIENNES, 1833, 'Hist. Nat. Poiss.,' IX, p. 40. Martinique.

*Caranx Jacobaeus* CUVIER AND VALENCIENNES, 1833, 'Hist. Nat. Poiss.,' IX, p. 42. Cape Verdes.

HABITAT.—Atlantic.

***Decapterus macarellus pinnulatus* (Eydoux and Souleyet)**

*Caranx pinnulatus* EYDOUX AND SOULEYET, 1841, 'Voy. "Bonite,"' Zool., I, p. 165, Pl. III, fig. 1. Hawaiian Islands.

HABITAT.—Pacific.

Depth in length to base of caudal, 5.5 (at 220 mm.) to 6.2 (at 180 mm.); head, 4 to 4.1. Eye in head, 4 to 4.5; pectoral, 1.5. Dorsal soft rays, 32 to 34—1; anal, 27 to 28—1. Scales, about 104 + 25 to 27 more or less well-developed scutes occupying about 0.5 of the straight part of lateral line, which is contained about 1.2 in the curved part. No scaleless supra-occipital area on top of head.

Dark above to mid-line of sides; whitish below; a blackish opercular spot. Lining of gill-cavity grayish or silvery, with dark specks above and behind (at 180 to 200 mm.) and showing other dark marking in a larger fish (of 220 mm.).

***Decapterus macarellus macrosoma* Bleeker**

*Decapterus macrosoma* BLEEKER, 1851, Nat. Tyds. Ned. Ind., I, p. 358. Sea of Batavia.

HABITAT.—East Indies and Indian Ocean.

**Decapterus macarellus leptosomus** Ogilby

*Decapterus leptosomus* OGILBY, 1898, Proc. Linn. Soc. N. S. Wales, (2) XII (1897), p. 760. Port Jackson.

HABITAT.—Australia.





## NEW AFRICAN DIPTERA

By C. H. CURRAN

Descriptions of a number of new African flies are given in the following pages. Many of these have been in my possession for a number of years, awaiting additional material. The types are mostly in The American Museum of Natural History, but some of them have been returned to Mr. H. K. Munro, who has expressed the intention of depositing them in the South African Government Collection.

## Metopiidae

## LAMPROMETOPIA MACQUART

MACQUART, 1846, 'Dipt. Exot.,' Suppl. 1, p. 158.

*Hoplocephalella* VILLENEUVE, 1913, Rev. Zool. Afr., III, p. 112.

This genus is related to *Hoplocephala* Macquart, but is readily separated by the presence of only one anterodorsal bristle on the middle tibiae. In all the species the eyes are conspicuously haired in the males, but the hair is so short in some of the females that the eyes appear to be bare. While there is considerable variation in the width of the frontal vitta in the males, the females are so similar that they are not easily separated. There are usually three sternopleural bristles, but the middle one is often weak. The following key separates the forms I assign to this genus.

## TABLE OF SPECIES

- 1.—Fourth abdominal segment with three large, shining black spots above apically. 2.  
Fourth abdominal segment practically all pollinose, at most with two small, sub-shining black spots.....*pollenia*, n. sp.
- 2.—Aristal pubescence distinctly shorter than the thickened base of the arista.....3.  
Aristal pubescence fully as long as the thickened base.....*grisea* Villeneuve.
- 3.—Frontal vitta of male linear, of female, not half as wide as one parafrontal.  
*cafra* Macquart.
- Frontal vitta more than half as wide as parafrontal.....*pretoria*, n. sp.

*Lamprometopia pollenia*, new species

Readily recognized by the wholly pollinose fourth abdominal segment, although there is an indication of a pair of spots on this segment in the female. Length, 6 to 8.5 mm.

**MALE.**—Head black, silvery pollinose, the parafrontals with brassy tinge above; frontal vitta blackish, with trace of pale pollen above; front two-thirds as wide as one eye. Eleven pairs of frontals, the upper one or two pairs reclinate; three pairs of proclinate orbitals; ocellars moderately strong, proclinate or somewhat divergent; outer verticals strong. Cheeks one-third the eye-height; parafacials as wide as the facial depression, with scattered short hair. Palpi brown. Antennae black, the third segment twice as long as the second and narrower than it; arista pubescent, brown beyond the thickened base. Eyes thinly pilose.

Thorax cinereous pollinose, the mesonotum with yellow tinge, the usual five dark vittae present, all narrow except the outer ones. Normally three sternopleurals, the second sometimes absent.

Legs black. Wings cinereous hyaline; third vein with two or three basal bristles. Squamae whitish.

Abdomen cinereous pollinose above, the disc with yellow tinge, the venter almost all shining blackish. First segment with three very large, anteriorly connected shining black spots. Second segment with a rather narrow median black or brown vitta and a moderately large, subtriangular shining blackish spot toward each side; third segment similarly marked except that the median vitta is linear, and brown in color; fourth segment wholly pollinose, or with very small lateral black spots.

**FEMALE.**—Front as wide as one eye; upper frontal bristle sometimes simulating a reclinate orbital; palpi reddish brown; antennae brownish red basally, the third segment sometimes reddish brown. Abdomen with three shining black vittae composed of posteriorly widening spots, that extend the full length of the segments from posterior view, but are limited to the posterior half when seen from in front. Fourth segment wholly pollinose or with very small black spots.

**TYPES.**—Holotype, male, Pretoria, Transvaal, March 8, 1928 (H. K. Munro). Allotype, female, Pretoria, January 10, 1914. Paratypes, male and female, Pretoria, March 8, 1928 and January 2, 1914 (H. K. Munro). The holotype has been returned to Mr. Munro.

### *Lamprometopia grisea* Villeneuve

*Hoplocephalella grisea* VILLENEUVE, 1916, Ann. S. Afr. Mus., XV, p. 509.

Black, the arista with pubescence longer than the basal swollen portion. Length, 4 to 5 mm.

**MALE.**—Front half as wide as one eye; eight or nine pairs of frontals, the upper simulating a reclinate orbital; three pairs of proclinate orbitals; ocellars weak, divergent; frontal vitta silvery white pollinose above. Head black, silvery white pollinose. Cheeks one-fifth the eye-height. Parafacials little more than half as wide as the facial depression, with sparse, short, black hair. Palpi black. Antennae brown, the third segment scarcely twice as long as the second and not as wide; arista thickened basally, the pubescence fully as long as the thickened base. Eyes sometimes practically bare.

Thorax cinereous pollinose, the black vittae somewhat obscure. Three sternopleurals, the lower weak.

Legs black. Wings cinereous hyaline; third vein with three or four basal bristles. Squamae whitish.

Abdomen cinereous pollinose above, with three shining black vittae, the seg-

mental spots widest posteriorly; spots on fourth segment large. Venter thinly cinereous pollinose.

**FEMALE.**—Front as wide as one eye; tip of second antennal segment luteous, the third segment as wide as the second; arisal pubescence conspicuously longer than the basal thickened portion. Pollen of thorax and abdomen with yellowish tinge on the upper surface.

Male, Barberton, South Africa, May 22, 1913 (H. K. Munro); female, Pretoria, March 8, 1928 (Munro).

#### *Lamprometopia pretoria*, new species

Black; abdomen with three shining black vittae; arista very short pubescent. Length, 5 to 5.5 mm.

**MALE.**—Head black, rather silvery white pollinose. Front two-thirds as wide as one eye; nine pairs of frontals, the upper pair sometimes simulating a reclinate orbital; three pairs of proclinate orbitals; ocellars divergent or obliquely proclinate; outer verticals long. Cheeks one-fifth the eye-height. Parafacials somewhat narrower than the facial depression, with scattered short black hair. Palpi brown or reddish brown. Antennae black; third segment narrower than the second and about twice as long; arista short pubescent. Eyes with rather thin short hair.

Thorax cinereous pollinose, with the usual black vittae. Two or three sternopleurals, the median one weak or absent.

Legs black. Wings cinereous hyaline; third vein with two or three basal bristles. Squamae whitish.

Abdomen cinereous pollinose above, with three shining black vittae formed of anteriorly narrowed spots, those on the fourth segment usually not reaching the base of the segment. Venter shining black, sometimes more or less reddish toward the sides on the median half. Apical segments usually with yellowish tips.

**FEMALE.**—Front as wide as one eye; second antennal segment sometimes reddish or brownish red; the third segment as broad as the second.

**TYPES.**—Holotype, male, Pretoria, Transvaal, January 2, 1914. Allotype, female, Pretoria, January 5, 1916. Paratypes, two males, two females, Pretoria, January 10, 1914, September 8, 1914, December 16, 1913, and March 13, 1928, all collected by H. K. Munro.

#### PTERELLA DESVOIDY

As limited by Townsend (1935) this genus contains only one known species from Africa (*Setulia rubriventris* Villeneuve), and the two forms described in the following pages. The other species described in *Setulia* by Villeneuve are referable to the genus *Sphixapata* Rondani.

#### TABLE OF SPECIES

- 1.—Abdomen not or only obscurely reddish.....2.  
Abdomen mostly reddish in ground color.....*rubriventris* Villeneuve.
- 2.—Abdomen with brown median vitta.....3.  
Abdomen with median shining black spots on second and third segments.  
*triseriata*, n. sp.



- 3.—Antennae reddish (Europe).....*grisea* Meigen.  
Third antennal segment and arista black.....*africana*, n. sp.

*Pterella triseriata*, new species

Black, the face and front yellowish in ground color. Length, 6 mm.

**FEMALE.**—Head white pollinose, the parafrontals somewhat yellowish above; frontal vitta luteous yellow, with a long prolongation of white pollen in front of the ocelli; nine or ten pairs of frontals; two pairs of proclinate orbitals and two or three reclinate orbitals above; ocellars moderately long; front three-fourths as wide as one eye. Occiput black in ground color except immediately below the vertex; cheeks black behind. Vibrissae conspicuously stronger than the adjacent bristles; para-facials almost as wide as the facial depression, with very small, yellow hairs. Antennae and palpi reddish, third antennal segment and arista blackish, the former more or less reddish at the base.

Thorax rich yellowish brown pollinose, with five rather obscure black vittae, the submedian pair obsolete on the posterior half; pleura yellowish cinereous pollinose; sternopleurals 1-1 or 1-1-1.

Legs black. Wings cinereous hyaline; squamae mostly tinged with brown.

Abdomen yellowish cinereous pollinose, brownish beneath, but from most views appearing chiefly shining black; apical third of the fourth segment shining black; first to third segments each with a large, suborbicular shining black spot in the middle and toward either side. Second segment with weak, appressed marginals, the third and fourth each with a row.

**HOLOTYPE.**—Female, Bloemfontein, South Africa, December 4, 1920 (H. E. Irving); returned to Mr. H. K. Munro.

*Pterella africana*, new species

Related to *grisea* Meigen, but distinguished by the blackish third antennal segment and mostly shining fourth abdominal segment. Length, 6 to 7 mm.

**FEMALE.**—Head white pollinose, the parafrontals becoming yellow above; face and front yellow in ground color; the frontal vitta pale orange. Nine or ten pairs of frontals; two pairs of proclinate orbitals and one or two reclinate orbitals on each side; ocellars moderately long. Front less than half as wide as either eye. Occiput black except immediately below the vertex. Para-facials narrower than facial depression, with scattered, inconspicuous, pale hair. Palpi and antennae reddish; third antennal segment and arista black, the former reddish at the base; arista thickened to beyond the middle.

Thorax cinereous pollinose; mesonotum and scutellum with brown pollen, the former rather cinereous laterally; mesonotum with five indistinct, narrow, dark vittae, the submedian pair limited to the anterior half. Sternopleurals 1-1. a weak third sometimes present in front of the posterior.

Legs black, largely cinereous pollinose; posterior tibiae sparsely ciliate on basal three-fourths.

Wings cinereous hyaline; squamae yellowish, with slight brown tinge on disc.

Abdomen with cinereous pollen on the sides and basal half of the venter and light brownish pollen on the disc. The first segment is mostly shining, or very thinly pollinose on the disc, the second with a wide median brownish black vitta, the third with a more or less distinct brown vitta; fourth segment shining black, the basal third polli-

nose except laterally; second and third segments each with a large, oblique, shining black spot on either side. Second segment with appressed marginals, the third and fourth with erect row.

Types.—Holotype, female, Pretoria, South Africa, February 14, 1928 (H. K. Munro). Paratype, female, Uitenhage, South Africa, February 11, 1919 (H. K. Munro); returned to Mr. Munro.

#### AMOBIA DESVOIDY

DESVOIDY, 1830, Mem. Acad. Roy. Soc. Inst. France, II, p. 96.

*Pachyophthalmus* BRAUER AND BERGENSTAMM, 1889, Denkschr. Akad. Wien, LVI, p. 117.

The following Old World species are represented in the collection before me.

#### TABLE OF SPECIES

- 1.—Sternopleura with eight or more hairs near the bristles.....2.  
Sternopleura with only two or three hairs near the sternopleurals. *africa*, n. sp.
- 2.—The brown mesonotal vittae extend almost to the apex of the scutellum; abdominal markings dull.....*capensis*, n. sp.  
Base of scutellum broadly brown (Europe).....*signata* Meigen.

#### *Amobia africa*, new species

Black, with cinereous pollen. Length, 4 to 7 mm.

MALE.—Head white pollinose. Front one-third as wide as one eye; frontal vitta black; ten to twelve pairs of frontals, the upper two reclinate; about ten pairs of parafrontal hairs, the tiny hairs not numerous; ocellars moderately strong. Cheeks with sparse black hair. Parafacials with tiny black hairs, about as wide as the third antennal segment. Palpi and antennae blackish; arista thickened on basal third.

Mesonotum with three shining brown vittae that extend almost to the apex of the scutellum. Three pairs of postsutural dorsocentrals; one or two pairs of rather short presutural acrosticals. Sternopleurals 2-1, the lower short.

Legs black, the pulvilli of median size; posterior tibiae sparsely ciliate.

Wings cinereous hyaline; third vein with two basal bristles. Squamae whitish.

Abdomen with cinereous pollen; with a rather narrow median brown vitta that may be narrowly interrupted on the front of each segment and broader on the posterior border, and a wider, irregular, vitta on either side the spots comprising it partly contiguous over part of their width; on the fourth segment the shining brown spots are limited to the apical half, and may be contiguous. The first and second segments each bear a pair of median marginals, the third and fourth with complete rows. Venter rather thickly pollinose, with a row of large, diffuse brown spots on each side.

FEMALE.—Median brown vitta on scutellum paler in color; pulvilli small; abdomen more tessellate.

Types.—Holotype, male, and allotype, female, Hartley, Southern Rhodesia, December, 1930. Paratypes, four females, Hartley, November and December (no collector label), and one male, Gatooma, Southern Rhodesia, January, 1928 (A. Cuthbertson).

*Amobia capensis*, new species

Black, cinereous pollinose, the brown mesonotal vittae extending well onto the scutellum. Length, 5.5 to 8 mm.

MALE.—Head white pollinose, the parafrontals with yellowish tinge; frontal vitta brown. The short parafrontal hairs are quite conspicuous and arranged in two irregular rows that extend to below the middle of the parafacials; row of parafrontal hairs rather fine. Ocellars moderately long. Cheeks with short black hair. Parafacials about as wide as third antennal segment. Palpi and antennae blackish; arista thickened on basal third.

Mesonotum with three wide brown vittae that extend onto the scutellum, the middle one paler posteriorly. Mesonotal hair moderately long; only one pair of presutural acrosticals strikingly longer than the hair, the other two pairs poorly differentiated. Sternopleurals 2-1, the lower weaker; eight or nine fairly long hairs near the bristles.

Legs black; pulvilli of medium size; posterior tibiae sparsely ciliate.

Wings cinereous hyaline; third vein with three basal bristles. Squamae whitish.

Abdomen black, with an entire median brown vitta that widens posteriorly on each segment, and an irregular, broad lateral vitta formed of brown spots that are narrowly separated on the bases of the segments. The brown pollinose areas are moderately shining in some views. Chaetotaxy as in *A. africa*. Venter with transverse brown spots on the sides of the segmental apices.

FEMALE.—The tiny hairs of the front and face are not conspicuous; hair of the thorax short; pulvilli small; median abdominal vitta wider.

TYPES.—Holotype, male, Durban, Natal, 1912. Allotype, female, Pretoria, Transvaal, October 17, 1926 (H. K. Munro), in collection of South African Department of Agriculture.

## MILTOGRAMMA MEIGEN

Three African species belonging to this genus are before me. They may be separated as follows.

## TABLE OF SPECIES

- |  |                              |
|--|------------------------------|
| 1.—Mesonotum pollinose, at least in the middle anteriorly..... | 2.                           |
| Mesonotum shining black.....                                   | <i>cuthbertsoni</i> , n. sp. |
| 2.—Mesonotum wholly pollinose.....                             | <i>munroi</i> , n. sp.       |
| Mesonotum with pollinose vittae in front of the suture.....    | <i>hirtimanum</i> Bezzi.     |

*Miltogramma cuthbertsoni*, new species

Mostly shining black above, the abdomen with deeply excised pale pollinose fasciae. Length, 7 mm.

MALE.—Head white pollinose, the front with yellowish tinge; occiput black in ground color except just below the vertex; front and face yellow. Front one-third as wide as either eye, the vitta dull orange; bristles weak, especially above; a pair of ocellar hairs separated from the posterior row; outer verticals relatively long; upper frontal strong and reclinate. Cheeks with short, fine yellow hair; parafacials three-fourths as wide as the facial depression, with minute yellowish hairs. Palpi yellowish. Antennae pale reddish, the third segment one-half longer than the second; arista black, thickened on the basal half.

Thorax shining black, the upper half of the pleura and the sides of the mesonotum cinereous white pollinose; mesonotum with bristles on only the posterior and lateral margins. Three sternopleurals, the anterior weak or even absent. Scutellum with the apex broadly reddish.

Legs black; pulvilli short; anterior tarsi without long hair.

Wings hyaline; third vein with two basal bristles. Squamae white.

Abdomen shining black; second and third segments with the basal fourth cinereous pollinose, the pollen strongly, triangularly produced posteriorly on each side of the middle and more so laterally; the ground color beneath the pollinose triangles is more or less reddish; on the fourth segment the pollen extends more or less distinctly to the apex. Middle of the venter broadly pollinose on the whole length. First segment dorsally with some pollen basally and on the sides. To the naked eye the pollen appears white, but under magnification it has an ochraceous tinge. Third and fourth segments each with row of erect marginals.

TYPE.—Male, Salisbury, Southern Rhodesia, September 20, 1932 (A. Cuthbertson).

### *Miltogramma hirtimanum* Bezzi

BEZZI, 1912, Rev. Zool. Afr., II, p. 80.

Male, Eden, Cameroons (J. A. Reis). Originally described from the Belgian Congo.

### *Miltogramma munroi*, new species

Differs from *hirtimanum* Bezzi in having the mesonotum trivittate. Length, 7 to 8.5 mm.

MALE.—Head yellowish in ground color, the occiput black; pollen white, yellow on the front and parafacials; frontal vitta pale orange. About fifteen pairs of rather weak frontals, the upper pair strong and reclinate; three pairs of weak orbitals; ocellars replaced by two rows of hairs. Cheeks with short, fine whitish hair; parafacials with tiny whitish hairs. Palpi and basal antennal segments reddish; third antennal segment brown with reddish base; arista black, the apical third sometimes brown.

Thorax cinereous pollinose; mesonotum with three broad black vittae that extend almost to the apex of the scutellum, and a pair of narrow, submedian black vittae on the anterior half; hair rather long, the bristles on the disc not strikingly differentiated. Sternopleurals 1-1 or 1-1-1. Scutellum with almost the apical half reddish yellow.

Legs black; pulvilli small; intermediate segments of the anterior tarsi subequal in length, the second with four long, bristle-like hairs above, the third with two; posterior tibiae sparsely ciliate on basal two-thirds.

Wings cinereous hyaline; third vein with two basal bristles. Squamae whitish.

Abdomen mostly reddish beneath, dark apically, the reddish color extending broadly onto the dorsum over at least the basal half of the second and third segments, the black posterior bands sometimes almost eliminated on the sides of the first segment and weak on the second. The cinereous pollen covers the basal two-thirds of the segments except for a narrow median vitta, adjacent to which the pollen is produced back to the posterior fourth of the second and third segments. The median

vitta is absent on the fourth segment, the pollen here sometimes covering only the basal half. There are erect marginals only on the apical two segments, those on the second segment being appressed and weaker.

**FEMALE.**—Hair of thorax shorter, the bristles slightly more evident. The red color is but little evident on the abdomen and the pollen is limited to the basal half of the segments.

**TYPES.**—Holotype, male, and allotype, female, Barberton, Transvaal, August, 1913 (L. S. Hardenberg). Paratypes: male, Barberton, August 12, 1916 (H. K. Munro), and male, Pretoria, Transvaal, December 13, 1919 (Munro). The types will be returned to Mr. Munro.

## Tachinidae

### HYALOMYA DESVOIDY

Without specimens it is not possible to prepare a satisfactory table for the separation of all the described species from Africa so only those represented in the collections before me are included.

#### TABLE OF SPECIES

- 1.—Costa with ordinary bristles at base.....2.
- Costa with long, dense, scalelike basal bristles.....4.
- 2.—Oral margin very strongly produced and somewhat snoutlike.....3.
- Oral margin only slightly produced.....*cuthbertsoni*, n. sp.
- 3.—Apical cell distinctly wider than the discal cell in both sexes; wing of male without brown tinge apically.....*nasuta* Loew.
- Apical cell not as wide as discal cell; wing with brown cloud in front toward the apex.....*capensis* Schiner.
- 4.—Anterior femora with scalelike bristles at least above.....5.
- Anterior femora without scalelike hairs or bristles.....*negator*, n. sp.
- 5.—Wings of the male usually broadly hyaline apically; abdomen with subsquamose hairs only ventrally.....6.
- Wings of male distinctly brownish on the whole length in front of the third vein; abdomen with squamose hairs on the sides of the dorsum.....*argentifrons* Walker.
- 6.—Wings deep brown in front of the fifth vein, the discal cell wholly brownish.  
*munroi*, n. sp.
- Wings pale brownish yellow anteriorly.....*victoria*, n. sp.

### *Hyalomya cuthbertsoni*, new species

Black, the abdomen with cinereous cross-bands in the female; thorax rather thinly cinereous pollinose; oral margin not strongly projecting. Length, 4.5 to 7 mm.

**MALE.**—Head silvery white pollinose; hair black, white on the cheeks and lower occiput; vertical triangle without white pollen, the eyes practically contiguous for two-fifths the length of the front, the upper facets enlarged. Proboscis stout; palpi reddish. Antennae black, the third segment one-half longer than wide; arista black, thickened on the basal fourth.

Thorax cinereous pollinose, the pollen thin on the dorsum except on the humeri and notopleura; basal half of the scutellum without pale pollen. Hair wholly black; usually only one sternopleural, the anterior one weak when present.

Legs black, black-haired; claws and pulvilli long.

Wings hyaline, rather broadly yellowish basally, some of the veins yellow on the basal half of the wing; apical cell not broadened, the posterior cross-vein near the middle of the apical cell. Squamae cinereous, the halteres reddish yellow.

Abdomen shining black, the sides, apex and venter with cinereous pollen; sides of the basal two segments and most of the under surface, including the genitalia, reddish. Hair black, white on the under surface except at the sides.

FEMALE.—Squamae more luteous; third and fourth abdominal segments cinereous pollinose, the second with a linear, incomplete basal fascia that widens laterally and is visible only from posterior view; abdomen sometimes wholly black.

TYPES.—Holotype, male, and allotype, female, Gatooma, Southern Rhodesia, May, 1934, from cage of *Dysdercus fasciatus* (No. 3834A). Paratype, female, Peddie, East London, Cape Province, May, 1924 (H. K. Munro).

#### *Hyalomya nasuta* Loew

LOEW, 1852, Bericht. Kongl. Akad. Berlin, p. 660; 1862, Peter's 'Reise Mozamb.', V, p. 26.

Male and female, Salisbury, Southern Rhodesia, November 4, 1924; female, East London, South Africa, April 26, 1925 (H. K. Munro); female, on daisy, Salisbury, June 14, 1932 (A. Cuthbertson).

The two sexes show no difference in color. I am not entirely certain that these specimens represent *nasuta* as the wings are not brownish basally and in front, but are luteous.

#### *Hyalomya capensis* Schiner

*Alophora capensis* SCHINER, 1868, 'Novara Reise,' Dipt., p. 337.

Male, Barberton, November 9, 1917 (L. S. Hardenberg); two females, East London, August 12, 1922, and April 25, 1925; female, Peddie, December 27, 1921; female, Egerton, January 16, 1925, and female, Umdanzani, East London, Cape Province, May, 1924 (H. K. Munro).

The male is readily distinguished from *nasuta* by the almost wholly white pollinose mesonotum but the females can be separated only by the distinctly narrower apical cell in this species.

#### *Hyalomya argentifrons* Walker

*Phasia argentifrons* WALKER, 1849, 'List. Dipt. Brit. Mus.,' IV, p. 691.

Male and female, Weenen, Natal (H. P. Thomasset); two males and one female, Barberton, August, 1913, and September 11, 1919 (Munro Collection).

Walker's description is very poor since the wings are hyaline on about the posterior half, the luteous oral margin is strongly produced and there are scales on the femora and abdomen in addition to those on the wings.

The female has hyaline wings and almost all silvery-gray pollinose abdomen and lacks the scales except on the wings.

*Hyalomya munroi*, new species

Wings brown, whitish basally behind, the apex broadly hyaline; abdomen with long scalelike pile laterally. Length, 5 mm.

MALE.—Head black, white pollinose; occipital cilia fine, black, the cheeks with white hair. Front with short, weak bristles and an irregular row of hairs extending from the antennae almost to the ocelli, the frontal vitta linear above, strongly widening anteriorly; eyes separated by twice the width of the anterior ocellus; vertical triangle with black hair. Anterior oral margin luteous, very strongly produced. Palpi brownish red; proboscis as long as the head. Antennae black; third segment elongate oval; arista whitish, black and thickened on the basal third.

Thorax black in ground color. Mesonotum with cinereous pollen, becoming rather ochreous on the disc, the posterior third shining black except for a median stripe and an incomplete transverse prescutellar band, the black extending broadly forward to the suture inside the lateral margins; scutellum black, slate gray on the apical half. Pleura cinereous pollinose. Hair black, dense and scalelike on the humeri, upper and posterior borders of the mesopleura and on the upper part of the pteropleura.

Legs black; coxae cinereous pollinose, and white-haired, the middle pair with some white scales behind. Hair black, white on the basal half of the posterior surface of the middle femora and on the base of the front femora posteriorly; anterior femora with two rows of black scales on the apical half of the lower surface and dense, long brown scales above; middle femora with two complete rows of blackish scales below and a patch of posterodorsal scales apically; posterior femora with long brown scales above and on the posteroventral surface, the anteroventral surface with isolated shorter scales; middle femora with some white scales basally; posterior tibiae ciliate above with short black scales.

Wings brown, whitish or grayish white behind the fifth vein, the apex broadly hyaline; base of the costa with long, curved black scales, the costa with short, squamose hairs before the first vein. Apical cell broader than the discal cell, the vein closing the discal cell unusually close to the wing margin.

Abdomen shining greenish black, the fourth segment bordered with cinereous pollen except in the middle anteriorly, the pollen forming large basal triangles on the sides of the segment; venter cinereous pollinose; sides of the abdomen with long brown scales above and with yellow ones below on the fourth segment, the hair black above, whitish on the sternites.

HOLOTYPE.—Male, Muizenberg, Cape Peninsula, South Africa, November 16, 1931 (H. K. Munro); returned to Mr. Munro.

This species is rather similar to *argentifrons* Walker and has wide wings. The venation is different. Since the females are very different from the males in appearance it will probably be difficult to separate the female of *munroi* from *argentifrons*; in this sex the wings are narrower and wholly hyaline and the abdomen mostly cinereous pollinose.

*Hyalomya victoria*, new species

Wings hyaline, dilute brownish on the basal half in front of the fifth vein, the base of the costa with scales; femora with scales above; black, the strongly produced oral margin luteous. Length, 4 mm.

MALE.—Head silvery white pollinose, the hair black, white on the cheeks and lower occiput. Eyes separated by the width of the anterior ocellus; frontal vitta brownish red, linear above; a single row of frontal hairs and bristles. Anterior oral margin strongly produced forward, luteous. Palpi reddish yellow. Antennae black; third segment elongate oval; arista yellowish beyond the thickened basal fourth.

Thorax black, cinereous pollinose, on the mesonotum with a pair of broad, diffuse, brownish pollinose vittae, the posterior half of the mesonotum and the broad sides as far forward as the suture shining black. Hair black. Scutellum with the broad apex thinly cinereous pollinose. Hair on the sides of the mesonotum in front and on the mesopleura long and slightly squamose; a single sternopleural.

Legs black; all the femora with squamose hairs above, the posterior pair with a posteroventral row; coxae cinereous pollinose.

Wings wide, hyaline, dilute brownish on about the basal half in front of the fifth vein, the brown color not nearly filling out the discal cell; apical cell wider than the discal cell; costa with scales on the basal section; alula hyaline. Squamae cinereous, with yellow border. Halteres yellow.

Abdomen black, the basal two segments reddish brown pollinose, the first more or less cinereous basally, the second shining posteriorly especially toward the sides where the pollen is strongly narrowed; lateral margins and apex of the abdomen cinereous pollinose. Venter with cinereous pollen, the pile on the sternites white, on the tergites partly brownish yellow.

TYPES.—Holotype, male, Victoria, Southern Rhodesia, August, 1932 (A. Cuthbertson). Paratypes, two males, Salisbury, Southern Rhodesia, June 14, 1932, on daisy (A. Cuthbertson).

*Hyalomya negator*, new species

Black, the wings yellowish brown to beyond the middle on the anterior half, the costa with scales basally; legs without scales. Length, 4.5 mm.

MALE.—Head silvery white pollinose, the hair black, white on the cheeks and lower occiput. Eyes practically touching for a short distance, the frontal vitta black; a single row of frontals. Oral margin strongly produced, shining black. Palpi brown, with reddish apices. Antennae black; third segment elongate oval, the upper apex somewhat angulate; arista black on the thickened basal fourth, the apical three-fourths luteous.

Mesonotum with argenteous pollen on the anterior half except on the broad sides; broad apex of scutellum argenteous from posterior view; pleura cinereous pollinose; hair black.

Legs black; anterior coxae cinereous pollinose; no scalelike hairs on the legs.

Wings brownish yellow, fading to hyaline apically and posteriorly; apical cell wider than the discal cell; basal section of the costa clothed with contiguous scalelike bristles. Squamae brown; halteres reddish yellow.

Abdomen bronze-black, the third and following segments clothed with silvery pollen, the hairs arising from dark dots. Venter probably cinereous pollinose (partly destroyed), the genitalia black.



HOLOTYPE.—Male, Matetsi, Southern Rhodesia, January 7, 1935 (R. H. R. Stevenson), No. 3998.

*Chaetolydella natalensis* Villeneuve

VILLENEUVE, 1916, Ann. S. Afr. Mus., XV, p. 490.

Male and two females, Krantz Kloof, Natal (W. J. Haygarth).

*Cuphocera hova* Villeneuve

*Cuphocera varia hova* VILLENEUVE, 1916, Rev. Zool. Afr., IV, p. 191.

Male and female, Maritzburg, S. Africa, March, 1908 (Cl. Fuller).

It is not possible at present to decide the identity of this form. Villeneuve differentiated it from *varia* Fabricius, described from Java, by the more abundant abdominal pollen, a character of little value. The male genitalia are quite different from *varia*. *C. argyrocephala* Macquart, described from northern Africa and recorded from southern Europe, has been placed as a synonym of *varia* by Villeneuve, but is probably distinct. *C. hova* may be identical with *argyrocephala*.

NEMORAEA DESVOIDY

The separation of the African species belonging to this genus is difficult at present owing to the absence of comparative tables. All of the species have the lower lobe of the squamae pilose above, although, in some species the hair is limited to the outer fourth.

TABLE OF SPECIES

- 1.—Four postsutural dorsocentrals.....2.  
Three postsutural dorsocentrals.....*longicornis* Villeneuve.
- 2.—Second and third abdominal segments without discals.....3.  
Second and third abdominal segments with discals.....*discoidalis* Villeneuve.
- 3.—Legs reddish brown or brown, the coxae in part, trochanters and apices of the femora sometimes reddish yellow.....4.  
Femora wholly reddish, the tibiae and tarsi sometimes blackish or brown.....5.
- 4.—Coxae reddish yellow; black, the abdomen with three whitish pollinose fasciae (*capensis* Schiner?).....*moerens* Villeneuve.  
Coxae blackish; abdomen broadly reddish laterally (Europe).....*pellucida* Meigen.
- 5.—Mesonotum with two conspicuous, broad black vittae.....6.  
Mesonotum with very narrow and inconspicuous vittae, posterior tibiae rarely partly brown.....7.
- 6.—Scutellum mostly black.....*miranda* Villeneuve.  
Scutellum wholly yellowish.....*intacta* Villeneuve.
- 7.—Abdomen wholly shining ferruginous red; wings evenly brown, without yellowish base, becoming paler posteriorly.....*fortuna*, n. sp.

- Abdomen usually with black vitta, always with pollinose fasciae; wings not uniformly brownish. . . . . 8.
- 8.—Lower squamal lobe almost wholly pilose above. . . . . 9.  
Lower squamal lobe pilose only on the outer fourth. . . . . *infoederata* Villeneuve.
- 9.—One pair of discal scutellars. . . . . 10.  
Two pairs of discal scutellars; posterior tibiae almost evenly closely ciliate. . . . . *capensis* Desvoidy.
- 10.—Parafacials not wider than the third antennal segment. . . . . 11.  
Parafacials considerably wider than the third antennal segment. . . . . *rubellana* Villeneuve.
- 11.—Sides of the mesonotum reddish; tarsal segments without black apices. . . . . *completa*, n. sp.  
Sides of the mesonotum blackish; tarsal segments with black apices. . . . . *incerta*, n. sp.

### *Nemoraea longicornis* Villeneuve

VILLENEUVE, 1916, Ann. Soc. Ent. France, XLV, p. 201.

Mostly rusty reddish; anterior tibiae with a bristle at the apical third of the posterior surface; three pairs of strong postsutural dorsocentrals; scutellum haired to the lower edge. Length, 7.5 mm.

**FEMALE.**—Front brown, the parafrontals with paler pollen; two pairs of orbital bristles and eight or nine pairs of frontals, the upper pair redinate; ocellars long; a secondary pair of rather long ocellars situated behind the ocellar triangle, the post-vertical bristles weak; verticals and outer verticals long and strong. Occiput blackish, cinereous pollinose, the hair black, yellowish in the middle below. Cheeks about two-fifths as wide as the eye-height, bearing sparse, black hair. Proboscis rusty reddish; palpi reddish yellow. Antennae reddish, the third segment mostly brown; arista brown.

Thorax rusty reddish, the mesonotum with a rather broad median black vitta on the anterior half. Pollen of the mesonotum cinereous yellow, from frontal view leaving a pair of very broad, apparently bare vittae on the anterior half, from posterior view with these vittae appearing whitish and dividing three pale pollinose vittae, the median one narrow; pollen of the pleura mostly cinereous white. One pair of strong acrostical bristles in front of the suture and another before the scutellum; dorsocentrals 2-3; three pairs of marginal scutellars and a pair of discals; scutellum haired to the lower edge. Propleural hair yellow; two sternopleurals.

Legs reddish yellow, the tarsi brown; hair and bristles black; anterior tibiae with a row of five anterodorsal bristles and one posterior bristle.

Wings cinereous hyaline; veins brown; third vein bristled almost to the anterior cross-vein. Squamae yellowish brown; suprasquamal declivities with some yellowish hairs.

Abdomen rusty reddish yellow, with black hair; third segment with moderately strong marginals, the others with weak ones, the first segment lacking bristles toward the middle.

Female, N. W. Tanganyika, 1910 (Grauer), in Vienna Museum of Natural History.

**Nemoraea discoidalis** Villeneuve

VILNEUVE, 1916, Ann. Soc. Ent. France, XLV, p. 198.

Three males, Uganda: Entebbe, April 1, 1914 (3857); Tero Forest, April 30, 1911 (2383); Kampala, 17, X, 1915, and one female, Nkokon-pira, 23, XII, 1910, all collected by Mr. C. C. Gowdey.

**Nemoraea miranda** Villeneuve

VILNEUVE, 1916, Ann. Soc. Ent. France, XLV, p. 200.

Male, Kampala, Uganda, December 8, 1916 (C. C. Gowdey); male, Entebbe, Uganda, March 10, 1911 (C. C. Gowdey).

**Nemoraea intacta** Villeneuve

VILNEUVE, 1916, Ann. Soc. Ent. France, XLV, p. 201, 1916.

Female, Paiata, Liberia, October 19, 1926 (J. Bequaert).

**Nemoraea fortuna**, new species

Readily distinguished from the other African species by the shining, reddish ferruginous abdomen. Length, 10 to 13 mm.

MALE.—Head whitish pollinose; front and occiput black in ground color, the face and cheeks reddish yellow. Front not greatly wider than the ocellar triangle, bearing twelve to fourteen pairs of frontals the parafrontals with sparse hair; ocellars scarcely developed; outer verticals absent. A partial row of hairs behind the occipital cilia; black hair of the cheeks broadly connected behind with the hairs behind the eyes, the pile pale yellowish. Cheeks almost half as wide as the eye-height, with two weak bristles below. Parafacials narrower than the third antennal segment; facial ridges with fine bristles on the lowest third. Palpi broken off in male, in female reddish yellow, with short black bristles above and a few long fine bristles on the outer edge. Antennae reddish; arista brown, pubescent.

Thorax black, rather thinly cinereous pollinose; humeri and pleura mostly reddish; scutellum shining ferruginous red; bearing one pair of discals and four pairs of marginals, hair wholly black; acrosticals, 3-2; dorsocentrals, 3-4; sternopleurals, 1-1.

Legs reddish, the tarsi scarcely darkened; posterior tibiae sparsely short ciliate, with two longer bristles in the row.

Wings smoky brown, becoming distinctly paler posteriorly. Squamae brownish, the lower lobe haired above on the outer fourth.

Abdomen shining ferruginous red, the bases of the segment with just a trace of pale pollen; hair wholly black. Fourth segment with scattered, strong discals, the second segment with a pair of marginals, the third with a row. Genitalia reddish, the posterior forceps ferruginous.

FEMALE.—Front four times as wide as the ocellar triangle, bearing two pairs of discals and about nine pairs of frontals; sides of mesonotum more or less broadly reddish; posterior tibiae with three or four long anterodorsal bristles; genital segments more or less ferruginous.

Types.—Holotype, ♂, Tshibinda, Tanganyika, August 21-27, 1931 (Alice Mackie). Allotype, female, and paratype, female, Burunga, Congo (J. Bequaert). The paratype is deposited in the British Museum of Natural History.

*Nemoraea infoederata* Villeneuve

VILNEUVE, 1916, Ann. Soc. Ent. France, XLV, p. 199.

Female, Uganda, Ruwenzori, May 16, 1911 (2692), collected by Mr. C. C. Gowdey.

*Nemoraea capensis* Desvoidy

*Meriana capensis* DESVOIDY, 1830, Mem. Acad. Roy. Sci. Inst. France, II, p. 71.

*Nemoraea rufipes* MACQUART, 1843, 'Dipt. Exot.', II (2), p. 54 (f.).

Readily distinguished from any species known to me by the white-haired, white squamae and the four posterior dorsocentral bristles. Rusty reddish, the front, occiput above, mesonotum except the sides, apices of tarsi and abdominal markings, black. Length, 13 mm.

FEMALE.—Front a little over two-thirds as wide as eye, strongly widened anteriorly. Head cinereous pollinose, the parafrontals thinly so above; frontal vitta rusty reddish, much narrower than either parafrontal; 12 to 15 frontals, the upper pair strong and reclinate; three pairs of orbitals; ocellars and postocellars rather weak; outer verticals about half as long as verticals. There is a row of tiny bristles inside the black occipital cilia which stop short of the lower edge of the eyes, but beneath, several rows of short, black, bristly hairs connect them with the bristles on the cheeks; occipital pile pale cinereous. Cheeks as wide as half the eye-height, bristly on the lower three-fourths. Oral vibrissae situated moderately above the oral margin, the facial ridges bristled on almost the lower half. Parafacials as wide as the length of the second antennal segment, wider above and below. Palpi reddish yellow, with black bristles. Antennae reddish, reaching to below the middle of the face, the third segment but little longer than the second, broadened apically; arista reddish, brown on the slender apical half, the penultimate segment slightly longer than wide. Eyes with sparse short yellowish pile.

Thorax gray pollinose, the vittae moderately distinct, the median pair diverging posteriorly; a short median one behind. Only the sides of the mesonotum are dark reddish, narrowly so behind. Scutellum wholly dull reddish, with four pairs of marginals, including the smaller, cruciate apical pair, and two pairs of discals. Acrosticals, 3-3; dorsocentrals, 3-4; sternopleurals, 1-1.

Legs reddish, the tarsi blackened from the apex of the first segment, although the base of the second may be broadly reddish.

Wings conspicuously tinged with gray, broadly yellowish in front on the basal half. Third vein bristled one-third the distance to the small cross-vein; no distinct appendage at the bend of the fourth vein.

Hollow of the first abdominal segment and a broad median vitta on the second and third, blackish, the vitta inclined to broaden and cover the broad posterior margins of the segments, on the third segment, narrowed basally where it is much narrower than on the preceding segment. First two segments without dorsal bristles; third with a pair of marginals and a row of marginals toward either side; fourth with two rows of bristles on the apical half and a terminal row of finer ones. Sternites reddish, each with one or two pairs of bristles.

Five females from South Africa, Pretoria, Feb. 21, 1913, and April 22, 24, 1917, collected by Mr. H. K. Munro.

*Nemoraea rubellana* Villeneuve

VILLENEUVE, 1913, Rev. Zool. Afr., III, p. 28.

Many specimens from Kabete, British East Africa, September 15, 16, 1918 (T. J. Anderson), and Narok, Masai Reserve, March 27 (Captain A. O. L. Luckman).

*Nemoraea completa*, new species

Abdomen reddish, with tapering black median vitta on the first three segments; squamae with black hairs scattered over the whole upper surface of the lower lobe; legs wholly reddish. Length, 14 mm.

MALE.—Rusty reddish except the front, occiput above and abdominal vitta. Head shining pale yellowish pollinose, the front and occiput above with more grayish pollen; parafrontals rather thinly pollinose, for the most part narrower than the rusty brownish frontal vitta; frontals strong, ocellars fairly strong, outer verticals absent. Front about one-fourth as wide as eye, widening anteriorly; frontal hairs black, short, evenly distributed. Occipital cilia reaching the lower fifth of the eyes, with a row of tiny black bristles between them and the orbits; occipital pile yellow. Cheeks slightly over half as wide as eye-height, clothed with bristly black hairs which are limited in front by a row of bristles. Vibrissae situated slightly above the oral margin, the ridges with bristles on the lower third and a secondary row of hair-like bristles outside them. Parafacials a little wider than the third antennal segment, somewhat widened above; facial carina well developed, rounded. Palpi reddish, with black bristly hairs. Antennae reddish, the third segment mostly tinged with brown and thinly pale pollinose, about as long as the second segment and scarcely as wide, the apex rounded; arista reddish, brown on the apical half, short pubescent, the penultimate segment longer than wide.

Thorax rather thinly grayish pollinose, the vittae obscure; sides and posterior border of mesonotum dark reddish, humeri paler. Acrosticals 3-2, dorsocentrals, 3-4; sternopleurals, 1-1; scutellum with five pairs of fairly strong marginals, including the cruciate apicals, and a weak discal pair. Hair of the thorax wholly black.

Legs wholly reddish, the tarsi appearing somewhat darker on account of the coarse, short black hair; no pale hairs on coxae or legs; pulvilli elongate, yellow.

Wings grayish posteriorly and apically, luteous basally, anteriorly and along the veins; third vein with short bristles extending halfway to the small cross-vein; no appendage at angulation of fourth vein. Squamae yellowish, a few yellow hairs exteriorly and basally. Halteres yellow.

Abdomen shining, the very narrow segmental bases white pollinose from posterior view; the black vitta ends at the apex of the third segment. Second segment with a pair of rather weak marginals, third with a row of eight, fourth with a median row of discals and a marginal row, the two joined laterally by one or more bristles, the apical row weak and erect. Genitalia red. Sternites with numerous long, hairlike bristles.

Types.—Holotype, male, Uganda, Entebbe, April 1, 1914 (C. C. Gowdey); in the British Museum of Natural History. Paratype, male, Chirinda, Southern Rhodesia, October–November, 1911 (G. F. M. Swynnerton).

This species is closely related to *rubellana* Villeneuve but is readily distinguished by the narrower parafacials and subciliate posterior tibiae.

*Nemoraea incerta*, new species

Related to *Miranda* Villeneuve but without the strong black mesonotal vittae. Length, 12 mm.

MALE.—Front, occiput and parafacials black in ground color, rather thickly white pollinose. Front rather narrow, not three times as wide as the ocellar triangle; about ten pairs of moderately strong frontals; ocellars long; hair of parafrontals rather fine. Occipital cilia extending to the black-haired cheeks; occipital pile pale yellowish. Cheeks a little more than one-half as wide as the eye-height. Parafacials without hairs above. Vibrissae long, the ridges with four or five bristles on the lower half. Palpi reddish, with short black hair, the outer edge with several long, fine bristles. Antennae reddish yellow, the third segment and arista mostly brown. Parafacials not as wide as the third antennal segment. Eyes with pale pile.

Thorax black, cinereous pollinose, with four incomplete, very narrow vittae; humeri and scutellum reddish yellow; hair wholly black. Acrosticals 3-2; dorso-centrals 3-4; sternopleurals 1-1; one pair of discal scutellars and four pairs of marginals, the apical pair cruciate.

Legs yellowish red, the tarsi black, tibiae and basal tarsal segment reddish brown or at least darker than the femora; hair wholly black; posterior tibiae not ciliate.

Wings brown, the apex and posterior border becoming cinereous-hyaline, the base rather yellowish in front.

Abdomen black above, the sides of the second and third segments very broadly rusty reddish yellow, leaving a broad black median vitta that expands on the third segment to occupy almost the posterior third, the black posterior fascia expanding at the sides; second segment with a small posterior triangle of black on each side. Basal half or less of the segments pale yellowish pollinose, the fourth pollinose on its whole length laterally. Under surface reddish yellow, the genitalia black and reddish. Hair black; fourth segment with a row of discals, the others with paired marginals.

HOLOTYPE.—Male, Eden, Cameroon (J. A. Reis).



# AMERICAN MUSEUM NOVITATES

Number 837

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

April 3, 1936

## A CLASSIFICATION AND PHYLOGENY OF THE ELASMOBRANCH FISHES

BY E. GRACE WHITE

The classification presented here is the result of extended research covering several years. The work was originally undertaken at the suggestion of Dr. W. K. Gregory, Curator of Ichthyology at The American Museum of Natural History in New York City, and the museum collections have been at my disposal at all times.

While engaged in this work it became apparent to me that the Order Galea was in need of complete reorganization, and in order to supplement the material available, I took an extended trip during a year's sabbatical leave to study the sharks of the Pacific and Indian Oceans. In 1930, I spent several months in Japan, where the collections of the Imperial University at Tokyo were placed at my disposal. Fresh sharks were also obtained from the markets, and some weeks were spent at the Marine Biological Laboratory at Misaki where very large specimens were obtained directly from the fishermen. In 1931 I spent several months in Java where the large wholesale markets made available sharks from a wide area. Here, also, I was able to examine an extensive collection at the laboratory maintained by the Dutch Government at Batavia. As the time at my disposal was limited it was not possible to include the Australian or Mediterranean types, but through the courtesy of Dr. T. Marini of Buenos Aires, who visited the Museum in New York in 1932, I was able to examine his collection of South American elasmobranchs, and to make the necessary dissections upon them.

A large number of specimens have been examined, therefore, both internally and externally, with many interesting results. The present publication is a mere prodromus of the complete report which is now ready for publication with illustrations, tables, and explanatory material. Full definitions and bibliography have therefore been omitted from this report.

I wish to express my appreciation at this time to Dr. W. K. Gregory and his associates of the Department of Ichthyology of The American Museum of Natural History in New York City for their cordial coöperation with this work at all times, and for the research facilities provided



at the Museum, and the contacts establishing during the years spent abroad.

To Dr. Naohide Yatsu, Dr. Negumi Eri, and Dr. Shigeho Tanaka who in 1930 made my stay in Japan a pleasant and profitable one, and especially to Dr. Tanaka for the invaluable material from his collections.

To Dr. H. C. Delsman and his associates at the Laboratorium voor Het, Onderzoek der Zee, Batavia, Java, for accession to the collections at the laboratory and for research facilities provided there in 1931.

To Dr. T. Marini, Guggenheim Fellow from Buenos Aires, for the loan of his South American collection in 1932.

The term Superclass is used for the Pisces and Class for the Chondropterygia. The class is defined as follows: exoskeleton of dermal denticles structurally identical with the teeth; spines primitively present; ceratotrichia present, lepidotrichia absent; endoskeleton cartilaginous, often calcified; membrane bone absent; elements of skull not separated by sutures; primary lower jaw (Meckel's cartilage) principal element; spines of pectoral arch absent, no bone cells in the arch; ribs typically of dorsal type; notochord more or less persistent; vertebral column with neural and haemal arches only; branchial arches 5-7; branchial openings separate, without opercula (except Chismopnea); paired nasal organs, each with one external opening; no air bladder or lungs; modern forms with internal fertilization and myxopterygia in the male.

Endings of parallel groups have been made uniform according to the following series; for Class "ia," for Subclass "i," Superorder "eae," Order "ea," Suborder "ida," Superfamily "oidea," Family "idae."

The basis of division between groups is determined by groups of characters. It is my belief that the deep-seated internal structures have a greater significance phylogenetically than the external characters which have fluctuated with changing environments. The latter have been used, therefore, for the most part to distinguish between genera and species, and the former between the larger groups.

#### KEY TO THE ORDER GALEA

- I.—Nictitating membrane absent; vertebral centra with four main uncalcified areas without calcified rods; radiating calcifications in the calcified areas, frequently branching, or rarely, with concentric laminae. . . . . SUBORDER ISURIDA.
  - A.—First dorsal posterior to the pelvis; rostral cartilages short,

not united; pectoral fins with radials on the mesopterygium and metapterygium about equal.

AA.—Caudal axis low; expanded propterygium and mesopterygium.....SUPERFAMILY ORECTOLOBOIDEA.

B.—First dorsal anterior to the pelvics; rostral cartilages three united; pectoral fins with radials mostly on the metapterygium.SUPERFAMILY ODONTASPOIDEA.

BB.—Caudal axis low; small propterygium and mesopterygium.....SUPERFAMILY ISUROIDEA.

II.—Nictitating membrane present or rudimentary; vertebral centra with calcified rays extending into each of the four main uncalcified areas; secondary calcifications in the form of a maltese cross; or vertebral centra showing all stages of development of type; rostral cartilages three, united; pectoral fin with well-developed propterygium and mesopterygium; caudal axis low.

SUBORDER CARCHARINIDA.

A.—Nictitating membrane rudimentary; vertebral centra showing all stages of development of type; oviparous.

SUPERFAMILY CATULOIDEA.

B.—Nictitating membrane more or less perfectly developed; vertebral centra of complete maltese cross type; ovoviviparous.

SUPERFAMILY CARCHARINOIDEA.

#### CLASSIFICATION

Superclass Agnatha

Superclass Pisces

Class Chondropterygia (elasmobranch fishes)

Subclass Stegoselachi (armored sharks)

Superorder Stegoselacheae

Order Stegoselachea

Family Macropetalichthyidae (Devonian)

Family Cratoselachidae (Carboniferous)

Subclass Rhenandini

Superorder Rhenandineae

Order Rhenandinea

Family Gemündinidae (Devonian)

Subclass Pleuropterygii

Superorder Pleuropterygeae

Order Cladodea

Family Cladoselachidae (Devonian, Carboniferous)

Family Symmoriidae (Devonian, Carboniferous)

Family Ctenacanthidae (Devonian-Permian)

Subclass Ichthyotomi

Superorder Pleuracanthae

Order Pleuracantha

Family Pleuracanthidae (Permian)

Subclass Plagiostomi (sharks and rays)

Superorder Antaceae (sharks)

Order Hexanchea

Suborder Hexanchida

Superfamily Hexanchoidea

Family Chlamydoselachidae

Family Hexaptrichidae

Order Galea

Suborder Isurida

Superfamily Orectoloboidea

Family Orectolobidae

Family Rhineodontidae

Superfamily Odontaspoidea

Family Carchariidae

Family Scapanorhynchidae

Superfamily Isuroidea

Family Vulpeculidae

Family Isuridae

Family Cetorhinidae

Suborder Carcharinida

Superfamily Catuloidea

Family Catulidae

Family Halaeluridae

Family Atelomycteridae

Superfamily Carcharinoidea

Family Triakidae

Family Galeorhinidae

Family Carcharinidae

Family Sphyrnidae

Order Heterodontea

Suborder Heterodontida

Superfamily Heterodontoidea

Family Heterodontidae

- Suborder Hybodontida
  - Superfamily Hybodontoidea
    - Family Hybodontidae (Triassic, Jurassic)
- Suborder Edestida
  - Superfamily Edestoidea
    - Family Edestidae (Carboniferous, Permian)
- Order Squalea
  - Suborder Squalida
    - Superfamily Squaloidea
      - Family Squalidae
      - Family Echinorhinidae
      - Family Scymnorhinidae
    - Superfamily Pristiophoroidea
      - Family Pristiophoridae
  - Suborder Rhinida
    - Superfamily Rhinoidea
      - Family Rhinidae
- Superorder Platosomeae (rays)
- Order Narcobatea
  - Suborder Narcobatida
    - Superfamily Narcobatoidea
      - Family Narcacientidae
- Order Batea
  - Suborder Batida
    - Superfamily Rhinobatoidea
      - Family Rhinobatidae
      - Family Pristidae
      - Family Discobatidae
    - Superfamily Rajoidea
      - Family Rajidae
    - Superfamily Dasybatoidea
      - Family Dasybatidae
      - Family Potomotrygonidae
      - Family Myliobatidae
      - Family Rhinopteridae
      - Family Mobulidae
- Subclass Bradyodonti
  - Superorder Bradyodonteae
    - Order Bradyodonteae
      - Suborder Bradyodontida

Family Petalodontidae (Devonian, Carboniferous, Permian)

Family Cochliodontidae (Devonian, Carboniferous, Permian)

Family Psammodontidae (Carboniferous)

Family Copodontidae (Carboniferous)

Subclass Ptyctodonti

Superorder Ptyctodonteae

Order Ptyctodontea

Suborder Ptyctodontida

Family Ptyctodontidae (Devonian, Mississippian)

Subclass Holocephali

Superorder Chismopneae

Order Chimaerea

Suborder Chimaerida

Superfamily Callorhynchoidea

Family Callorhynchidae

Superfamily Chimaeroidea

Family Chimaeridae

Family Rhinochimaeridae

Order Squalorajea

Suborder Squalorajdia

Superfamily Squalorajoidea

Family Squalorajidae (Jurassic)

Family Myriacanthidae (Jurassic, Cretaceous)

Class Acanthodia

Class Osteopterygia

## ORDERS OF THE ANTACEA

	HEXANCHAEA	HETERODONTEA	SQUALEA	GALEA
Dorsal fins	1	2	2	2
Dorsal fin spines	absent	present	present	absent
Anal fin	present	present	absent	present
Gill openings	5-7	5	5-6	5
Sixth gill arch	complete	absent	absent or complete	rudimentary
Jaw suspension	amphihyostylic	amphihyostylic to hyostylic	hyostylic	hyostylic
Pterygoquadrate articulation	loose	extensive	absent	loose or absent
Palatobasal process	present	present	absent	reduced
Rostral cartilages	single	absent	single	triradiate
Pectoral fin				
Mesopterygium	on margin of fin	not on margin	not on margin	not on margin
Radials on propterygium	none	1	1-several	1-several
Radials on mesopterygium and metapterygium	equal	about equal	about equal	unequal
Notochord	unconstricted anteriorly	constricted	constricted	constricted
Vertebrae	diplospondylic	monospondylic	monospondylic	monospondylic
Vertebral centra	undifferentiated anteriorly, asterospondylic posteriorly	modified tectospondylic	cyclo- or tectospondylic	asterospondylic
Myxopterygia				
Elements of stem	2	2	1-2	1
Axial cartilage	cylindrical and pointed	cylindrical and pointed	cylindrical and pointed	dorso-ventrally flattened
Ventral marginal	short and distal	short and distal	short and distal	elongate

## THE PHYLOGENY OF THE ELASMOBRANCHS

Modern elasmobranchs are a survival of a Paleozoic race, relatively unsuccessful as fishes, but of interest because they link the jawed vertebrates with the earliest known Agnatha. These were an armored race of jawless vertebrates appearing sporadically in the early Silurian for-

mations, becoming abundant in the late Silurian and Devonian, and becoming extinct at the close of the Devonian. Great progress has been made in the last decade or so due to the discoveries of Danish, Norwegian, and Swedish expeditions to Spitzbergen, East Greenland, and adjacent regions. The superb material thus revealed has enabled Stensiö to give accurate descriptions of the chambers containing the central nervous system and of the tubes transmitting the nerves and blood vessels of the head. The labors of Stensiö and Kiaer have resulted in many far-reaching conclusions concerning the relationships of these early forms.

Two groups are important phylogenetically: the Osteostraci which lead to the modern cyclostomes, and the Heterostraci which may lead to the elasmobranchs. The head and thorax are characteristically encased in an armor composed of a dorsal shield and a ventral shield, and sometimes two lateral shields. The abdominal region is covered with separate overlapping plates or with minute denticles. The axis of the tail is typically hypocercal, the axis of the body turning down.

The material of the shields on microscopic examination shows four layers of tissue: a basal layer which in the Osteostraci contains true bone cells, a cancellated layer, a reticular layer, and an external layer of dentine. The canals of the lateral line system pass through the reticulated layer and open by pores on the outside. On the ventral surface of the dorsal shield impressions of the internal structure are often found, showing the course of the lateral line system, the nasal openings, and the gill pouches. Some endoskeletal elements are found, and the brain case and nerves have been traced out.

In the Osteostraci there are numerous gills, from nine to fifteen, several of which lie anterior to the region of the spiracle in fishes. Each has a separate opening on the ventral surface. There is a single median nasal opening on the dorsal surface just back of the pineal impression, and the two very small orbits lie close together behind it. Stensiö has worked out the anatomy of cephalaspids in detail and finds that all the cavities and canals are lined with bone cells. The brain case, head shield, and gill cavities, all suggest the modern *Petromyzon*, as do also the single dorsal nasal opening and the two semicircular canals in the ear. Thus the cyclostomes today are a degenerate race, but are no doubt a survival of this ancient group.

The Heterostraci are less specialized and more primitive. They are very small, depressed grovellers, without appendages. The gills are only six or seven in number, and there is a single opening for them on

each side. The mouth is a slit on the ventral surface and the nasal opening seems to be within the slit. In rare cases two nasal sacs are reported. The armor has no bone cells and the dorsal shield varies from a single piece in *Poraspis* to minute denticles in *Thelodus*. Kiaer suggests that the single piece as found in *Poraspis* is primitive, and that the separate plates are due to the breaking up of the shield. Smith Woodward suggests that the shape of the plates is directly due to the arrangement of the soft parts underneath, but he believed (1915) that the plates are due to the fusion of the small denticles. If Kiaer is correct, the movements would serve to break up the plates, and the following series can be pictured.

*Anglaspis* has a dorsal shield with raised ridges of dentine forming a pattern. In *Cyathaspis* the shield is divided into four regions by distinct limits in the dentine layer. In *Pteraspis* the plates are separate and symmetrically arranged with fine concentric ridges, and in *Tolypaspis* the shield is broken into numerous small discs, each with a stellate ornamental peak, possibly representing the origin of the denticle. In *Thelodus* and *Lanarkia* the plates are all small, separate tubercles resembling the shagreen of the elasmobranchs. They are too specialized to represent a stage in the succession for they are extremely depressed at the anterior end, but they are found very late in the Silurian and so may well be derived forms.

Two groups of jawed vertebrates appeared in the late Silurian, both probably derivatives of the Heterostraci. The arthrodires were a grovelling group and the whole body was encased in a bony armor; the acanthodians were fusiform, fishlike forms in which the armor was composed of small quadrangular plates, larger on the head, and covered with a substance like ganoine, suggestive of the higher fishes. Fishlike paired and unpaired fins were present, all spiny, and in some forms accessory paired fins appeared. The spines have a remnant of the tubercular armor on their front margins, and each of the five pairs of gills has a separate opercular covering. These have sometimes been classed as sharks but the differences are too great. There is very little axial endoskeleton, and no endoskeletal support for the fins.

The elasmobranchs first appear in the lower Devonian. Probably the most primitive known is the small marine *Macropetalichthys primiensis* (E. Kayser). This was an armored shark retaining a dorsal shield composed of several bony plates but having an endoskeleton well preserved and distinctly on the elasmobranch plan (Broili, 1933). The body is depressed anteriorly but not extremely so. It dwindles to a



point at the tail with no unpaired fins, but the paired fins are large and have complete endoskeletal supports. That of the pectoral fins is of especial interest. There is a complete pectoral arch on which the three basals articulate. The metapterygium was not wholly preserved in the fossil but the shape of the piece found indicates that it was expanded like the mesopterygium and propterygium. All three were about the same size. Three unsegmented radials were preserved from the size of which it would seem that there were radials attached to all three basals and about as many on the mesopterygium as on the metapterygium. This is characteristic of the more primitive of the existing forms today, except that in all the modern sharks the radials are segmented into two or more pieces.

Such a fin appearing at this early period suggests the possibility that the paired fins of fishes had their origin from the Agnatha where the lateral appendages, when present, are outgrowths of the carapace. A primitive suggestion of such an outgrowth is found in *Anglaspis*, the heterostracian. The finely ridged dorsal shield is undivided but slight, blunt projections extend out from either side at about the position of the pectoral fins of fishes. Among the Osteostraci more definite appendages are found. In *Cephalaspis* the carapace curves in at this same region to form what is called the pectoral sinus, and from this point on each side a fleshy flap protrudes. If these represent primitive paired appendages, then the endoskeleton was a later development, probably due to the movements of the underlying muscles, and the three basal cartilages had a simultaneous origin. This is contrary to Balfour's theory of fin development in which the metapterygium is supposed to be older than the other two basals.

Smith Woodward (1915) considers the fusiform shape with the anterior dorsal fin as primitive, and believes that pelagic life preceded the grovelling life in any group. In the modern sharks, however, the slightly depressed groups retain more archaic characters than the fusiform, and, looking back through the geological record we can see that the grovellers must always have preceded the swimmers if only from the abundance of food on the bottom. Whether in fresh water or salt, invertebrates were the only source of food, and the first experiments toward vertebrate structure must have occurred where invertebrates were plentiful. This was not out in the open waters, and any attempts to venture into deeper waters must have been preceded by successful life near shore. It was only a few grovelling types which survived the close of the Devonian and, again, at the close of the Permian, when the

seas became practically devoid of animal life, it was the occasional grovelling elasmobranch which carried the race over the famine period to the more abundant Jurassic.

Therefore, the small grovelling forms may be looked upon as ancestral to any other type of vertebrate life, whether tending toward deep-sea types or more extreme bottom-living types. Romer has suggested that the heavy armor of the early forms may have been necessitated by the activities of the large voracious eurypterids, for these scorpion-like invertebrates were abundant during the same periods, and some were larger in size than many of the Agnatha. The Silurian vertebrates have left no clear record of chronology, but such specimens as have been found in the scattered remains of the earlier formations have been grovelling types such as *Cephalaspis*. No fusiform-shaped forms, either of the agnathan Anaspida, or of the acanthodians, appeared until the late Silurian formations when all of the known types are found in formations of about the same geological age.

Therefore, the facts do not preclude the grovelling type as primitive, and *Macropetalichthys* answers all requirements as a plausible ancestral type of the elasmobranchs. The earlier history must have been passed in the upper Silurian, parallel with the acanthodian development, but no record has been yet discovered. The armored elasmobranchs, or Stegoselachians, were not a large group, but they occur sporadically as late as the Carboniferous, when *Cratoselache* with its greatly reduced dorsal shield became extinct. *Gemündina*, a curiously specialized type with flattened and expanded pectorals very similar to the modern monkfish, occurred at a period slightly earlier than *Macropetalichthys* and shows that the tendency for reduction of the armor had begun at an earlier date. *Gemündina* has a large terminal mouth. The dorsal head shield has lost the central plates and the lateral head plates are fenestrated. The endoskeleton is quite plainly elasmobranchian.

In the late Devonian are found the first true elasmobranchs in which all that remains of the armor is the covering of dermal denticles and the dorsal fin spines. The spines are often greatly ornamented with dentine ridges and rows of tubercles. Tooth development determined the success of the group. In *Cladodus*, which is recognized as the central type, the teeth have a very broad base which is deeply embedded in the tissue of the jaw. There is a strong upright central cusp and numerous smaller upright lateral denticles. The teeth of *Macropetalichthys* were flat, round discs folded over the edge of the flat mandible. These may represent the base of the elasmobranch teeth, the cusps arising as ridges

of dentine arose on the carapace of the Agnatha. All of the Paleozoic elasmobranch teeth retained the broad base, only the Cretaceous sharks acquiring the two-rooted base which is less securely fixed to the jaw.

*Cladoselache* was a somewhat elongate deep-sea representative of the cladodonts. It was highly specialized and became extinct at the close of the Devonian. By some it has been looked upon as the primitive elasmobranch, but if the fin of *Macropetalichthys* is primitive, then the wide-based fins of *Cladoselache* are a specialization.

The tooth structure of *Cladodus* was successful if the fusiform shape was not, for all other known types of elasmobranch teeth can be traced back to this broad-based multicusped type. During the Carboniferous age tooth structure underwent specializations toward all types of environment. The only fusiform type was the very elongate *Pleuracanthus* which survived for a short time in the Permian and became extinct at the close of that period. The other types were all grovellers and the teeth were variously modified for grinding hard objects such as mollusc shells.

The Bradyodonti are a group apart but, according to A. S. Woodward, they probably lead to the modern chimaeras. Their broad-based teeth had slightly rounded crowns. These were crowded close together to form flat crushing pavements which were most effective in attacking mollusc shells. The teeth were largely composed of tubular dentine, a structure quite different from that of the ordinary elasmobranch teeth but found in the tritons of the modern *Chimaera*. The group includes *Petalodus*, *Cochliodus*, and *Psammodus*. None survived the Permian and no Triassic link has been found, but *Ganodus* and *Squaloraja* which appeared in the Jurassic lead direct to the chimaeras and must represent the survival of some such group in the Permian.

As the bases of the teeth were firmly embedded in the jaw it was not as easy for the series of teeth moving up to the margin to drop off as do the teeth of modern sharks, and this may account for the tendency toward fusion of the series. This reached its extreme in the symphyseal teeth of the edestids which protruded from the mouth in long spirals of fused teeth. *Edestus* and *Helicoprion* are extreme examples.

The teeth of *Notidanus* which appeared first in the Jurassic must have had their origin in the Carboniferous teeth. Here there is a differentiation between the teeth of the upper and lower jaws; those of the lower jaw having cusps in a receding series on an elongate base instead of a central cusp. This is not difficult to derive from the cladodont type, and their origin must have been from the stem forms in the Carboniferous before the hybodont teeth became established.

*Orodus* had obtuse elongate teeth with the dental crown raised in the middle. The surface was marked with more or less prominent wrinkles of dentine which rose from each long margin or from a median longitudinal crest. It was a crushing type but not fused into pavements. Toward the center the teeth retained a more cuspidate structure. It was this heterodont dentition which enabled the hybodonts to survive the extinction which closed the Paleozoic, when the dearth of food caused by the extinction of the invertebrates made life impossible for the vertebrates also.

There was little life in the early marine Mesozoic waters, but during the Triassic small bony fishes began to increase in numbers. The only elasmobranchs found are the hybodonts of which *Hybodus* is the Triassic type. The body is depressed and enlarged forward not unlike the modern Port Jacksons. In the Carboniferous types the dorsal fin spines were ornamented with ridges, but in *Hybodus* they are practically smooth and enamelled. The teeth are definitely heterodont, the central teeth being quite sharply cusped.

By the opening of the Jurassic food was again abundant and the elasmobranch fishes began once more diverging actively in all directions. This time the types were successful, for nearly all the Jurassic families are represented among the recent forms. Probably all of the fundamental skeletal changes were established during the Jurassic, and small specimens which have been found in the Lithographic stone of Bavaria have been most instructive even though lacking in many important skeletal details. The teeth are conspicuously absent from these fossils. Possibly this marks the change from the deeply embedded teeth, and if they were quite small and fragile they would have been less likely to be preserved. In the Cretaceous formations innumerable shark teeth are found often quite separate from the specimens, but these are all so like the modern forms that it is unfortunate that the linking types have not been preserved.

Some clue to their structure may be had from *Palaeospinax*, a hybodont of decidedly more modern character which appeared in the late Triassic or Liassic. It still retains the enamelled spines and the heterodont teeth, but the symphyseal teeth are very sharply cuspidate with only one pair of small lateral denticles, and the lateral teeth are low-crowned with several lateral denticles reduced to minute beads.

The vertebrae, too, diverged during this period. Knowledge of fossil vertebrae is scant and unsatisfactory and is usually from surface descriptions. Smith Woodward (1919) describes the vertebrae of

*Palaeospinax* as faintly asterospondylic, and Dean describes them as strongly cyclospondylic. In *Protospinax*, Smith Woodward describes concentric laminae which are characteristic of many of the squaloid sharks. It is a tectospondylic type. In *Crossorhinus jurassicus* he describes some calcification around the primitive double cone which would perhaps be a cyclospondylic type. No description is offered of the vertebrae of *Crossorhinops minus* (*Palaeoscyllium minus* Smith Woodward) or of *Palaeoscyllium formosum* Wagner (1861), but *Pristiurus* which is found in the later Jurassic had cyclospondylic vertebrae.

Among the modern groups the tectospondylic type with either concentric laminae or irregular radiations but without four main uncalcified areas is found in the Heterodontea (Port Jacksons), and in many of the Squalea and rays. The cyclospondylic type is found in the more typical of the Squalea and in the more primitive of the Catuloidea. The asterospondylic type is confined to the Galea, and two patterns have developed. In the Isurida, which includes the Orectoloboidea, the Odontaspoidea, and the Isuroidea, the calcifications are radiating, often branching, but always avoiding the four main uncalcified areas; in the Carcharinida, including the Catuloidea and the Carcharinoidea, the type has the calcifications in the form of a maltese cross with four short, stiff rods extending into the four main uncalcified areas. In the Catuloidea several stages exist between the purely cyclospondylic and the maltese cross type.

It is probable, therefore, that the type predominating in the Jurassic was cyclospondylic, and that any variation from that was toward the tectospondylic as found in the Heterodontea. As the radiations in this type resemble the asterospondylic in surface view, references to asterospondylic vertebrae in the Hybodontea may be taken to mean tectospondylic.

In deriving the modern groups from the Jurassic types only surface resemblances can be depended upon as the teeth are entirely lacking and the skeletal remains scant. *Protospinax* has the skeleton of the pectoral fin not far removed from that of *Macropetalichthys*. It is a type characteristic of the Squalea, and of the Orectoloboidea and Odontaspoidea of the galeoid sharks. These may therefore all be derived from *Protospinax* or some similar form. *Protospinax* has retained the spiny dorsal fins and the anal fin from the hybodonts. The position of the anal, and its small size, as well as the position of the dorsal fins, is paralleled in these small Jurassic forms by *Crossorhinops minus* and by *Crossorhinus jurassicus*. These two types have depressed heads, and

in *Crossorhinus* there are three pairs of dermal lappets. The general form is that of the modern *Orectolobus* which is a bottom living shark, primitive in many respects, and leading to both the Odontaspoidea and the Isuroidea. If *Protospinax* is the origin of this line, and if the concentric laminae in the vertebrae are the primitive squaloid type of vertebra, then the radiating calcifications of the Isuroidea may have risen from the tectospondylic and not directly from the cyclospondylic. This might explain the appearance of concentric laminae in the vertebrae of the two gigantic sharks, *Cetorhinus* and *Rhineodon*.

It is difficult to reconcile Smith Woodward's figure of his *Palaeoscyllium minus* with the *Palaeoscyllium formosum* of Wagner. There is so little resemblance, that I have changed the name of this type to *Crossorhinops minus* to show the much closer resemblance to the specimen of *Crossorhinus jurassicus* described by Smith Woodward. The small size and position of the anal fins is alike in both and quite different from *Palaeoscyllium formosum*. This latter type is more like the Catuloidea which group includes the *Scyllium* of Cuvier although that name has been abandoned in favor of *Catulus*.

The catuloids then show greater resemblance to *Palaeospinax* than to *Protospinax* and the Carcharinida would be less closely related to the Squalea than the Isurida, but probably derived from the same hybodont line. Since Dean describes the vertebrae of *Palaeospinax* as strongly cyclospondylic, and the vertebrae of the modern Catulidae are of that type, this origin is quite probable.

Except that they have lost the anal fin, the Squalea are very similar to *Protospinax*. The divergence to the Rhinidae was, also, started in the Jurassic with *Squatina*, and from these all of the modern rays may have been derived. All of these groups retained the larger spiracle which was an adaptation to shallow water breathing.

The Cretaceous saw the establishment of the more highly specialized families: *Odontaspis* founded the Carchariidae, *Oxyrhina* and *Lamna* the Isuridae, *Corax* the Cetorhinidae; thus, the Isurida, which was started by the Orectolobidae in the Jurassic, were all well on their way. Among the Carcharinida, which were begun by the Catulidae in the Jurassic, *Catulus* (*Scyllium*) represented the Catulidae and *Galeorhinus* (*Mustelus*) established the Galeorhinidae, but the large group of voracious sharks were not established until the Eocene when *Galeocерdo* and *Carcharinus* appeared. The Sphyrnidae are reported in the Eocene but were not well established until the Miocene.

Thus the more highly specialized the group of sharks, the later has

been their appearance geologically, and the entire group of modern sharks can be traced back, even over the break that closed the Paleozoic to the Devonian, and through the Devonian elasmobranchs to the Silurian Agnatha. While not the most successful group of fishes, therefore, they have had a longer history of survival than any of the bony fishes.

## THE HEART VALVES OF THE ELASMOBRANCH FISHES

BY E. GRACE WHITE

The heart valves of the elasmobranch fishes have been the subject of discussion from time to time and have been somewhat extensively described by Garman (1913). During my investigations leading to the classification of the elasmobranch fishes recently published (see American Museum Novitates No. 837) a great many heart valves were examined, and, since my conclusions do not entirely agree with those of previous investigators, the results are presented at this time.

The material used in this work has been collected over a series of years, and I am indebted to the following scientists and institutions for material and research facilities:

To Dr. W. K. Gregory and his associates of the Department of Ichthyology at The American Museum of Natural History in New York City for the use of material and research facilities at the Museum.

To Dr. Naohide Yatsu, to Dr. Negumi Eri, and to Dr. Shigeho Tanaka for access to valuable material and for research facilities at the Imperial University at Tokyo, and at the Marine Biological Laboratory at Misaki, Japan. Also to the old collector, Kuma Aoki, of the Laboratory for a specimen of the rare *Chlamydoselachus anguineus*.

To Dr. H. C. Delsman, and his associates at the Laboratorium voor Het, Onderzoek der Zee, Batavia, Java, for access to material, and research facilities at the laboratory.

To Dr. T. Marini of Buenos Aires for the loan of his South American collection.

As far as possible direct examination of the hearts has been made, but in cases where comparisons were necessary, and specimens not available, figures have been redrawn from the literature. The terminology used is that of my recent classification mentioned above.

In all fishes the conus arteriosus of the heart is functional and contains a varying number of valves. In the higher Osteopterygia there is a separation between the two regions of the conus, the anterior portion being strengthened, and the valves restricted to a single row in the



posterior portion. In the lower Osteopterygia, and in the elasmobranchs, there is no such division; the entire conus being valvular. The development within the elasmobranchs, therefore, does not parallel that of the typical fishes, but the conditions found in the lower Osteopterygia (see *Ceratodus forsteri*, Fig. 1i) is reminiscent of some of the higher elasmobranchs, and may be the continuation of a process begun in the lower group.

In the elasmobranchs the number of valves varies from three series of valves in two rows, as found in the Orectoloboidea, to four series in five rows in the Hexanchea, and six or seven rows in some of the rays. Although variation occurs even between members of the same species, still it tends to fall within limits characteristic of a group, or to show transitional stages toward a higher group, and for that reason the heart valves may be used as one of the contributing characters in establishing a classification.

The question is whether the small number or the large number is primitive. Garman (1885) suggests that the large number is primitive, and that reduction has occurred in the elasmobranchs with the increase of specialization. He admits, however, that the opposite appears to be true in the rays. Lankester (1878) suggests that duplication occurs in some cases in a longitudinal direction.

In the opinion of the author the tendency in the elasmobranchs is for duplication of valves rather than reduction, and this duplication may take place transversely as well as longitudinally. In some cases valves arising by longitudinal division in one row may be pushed downward, and thus give rise to an additional row.

Table I gives a graphic picture of my theory of relationships among the elasmobranch fishes based on the heart valves. Tables II, III, and IV show the number of rows found in specimens examined by dissection or described in the literature. Illustrations of all types, though not of all species, will be found in the figures. Where no reference is given the material has been dissected by the author and drawn direct from the specimen.

In the Hexanchea the tendency is for a large number of valves, usually in four series of four or five rows. Garman's figure of *Heptranchias perlo* shows three series of five rows, the row directly beneath the membranous valves being very minute. In 1885, Garman quoted Owen as saying that both *Hexanchus* and *Heptranchias* have four rows of valves. He himself describes two species, a young *Notorhynchus pectorosus* (*Heptranchias*) with five rows, and a large *Heptranchias*

*maculatus* with only three rows, but with traces in the middle of the conus as of two rows which he calls obsolete.

I find a mature specimen of *Notorhynchus pectorosus* with only four rows, but in four series which would seem to indicate duplication rather than reduction (Fig. 1a). A specimen of *Chlamydoselachus* shows four distinct series with five rows; the fourth row is in the process of duplication (Fig. 1d). This varies considerably from Garman's figure (1885) in which he shows only three series of valves. The fourth series has been found in no other group of the elasmobranchs but is frequently found in the Osteopterygia (Fig. 1i).

The valves of *Chlamydoselachus* are more membranous than those of other types, but there is a general resemblance between them. The conus is long, and the upper row of valves is membranous in all. The valves extend down by a chord to the lower row, some of which have thickened walls. A distinct tendency to duplication is apparent in all members of the order, and it is reasonable to look upon Garman's vestigial fifth row as a rudimentary fifth in *Heptanchias*.

On the theory of duplication it will be apparent that the Hexanchea have exceeded the usual speed of development. This is not unexpected, however, since it is a well-known fact that this group is highly specialized in certain characters while retaining others in archaic condition. This duplication is paralleled, also, in the spiral valves and in the gill openings.

The same appears to be true in the Odontaspoidea, another group with some archaic characters. In a specimen of *Scapanorhynchus owstoni* examined by the author (Fig. 1g) the valves do not differ from the one figured by Garman in 1913. It is clear that duplication in the transverse direction is in progress, for the chordae tendineae in the upper row of valves mark off a decidedly thickened area at the base of the membranous valves. These have not yet separated off, as no cleavage of the tissue has taken place. The same condition is found in a young specimen of *Carcharias taurus* (Fig. 1f) except that here the duplication is occurring in the second instead of the first row of valves. In both species the conus is shorter than in the Hexanchea.

Two rows are characteristic of the Holocephali, the Orectoloboidea, and the Catuloidea, but are the exception in other groups. Three rows are characteristic of the Odontaspoidea, although duplication is in progress. Three rows are also characteristic of the Carcharinoidea and of the Isuroidea. The only tendency to duplication in either of these groups is found in one species of the Galeorhinidae. The Isuridae, Carcharinidae, and Sphyrnidae are apparently well-stabilized groups.

One of the most interesting types found was *Catulus torazame* (Fig. 9d). The heart was taken from a mature female with complete egg cases in the oviduct and is not, therefore, in a transitional stage in the life of the individual. There is an obvious transverse duplication in progress here, and, since the typical number for the group is two rows, this bears out my conclusion that *Catulus torazame* is a transitional type approaching the stable condition prevailing throughout the Carcharinoidea.

In *Calliscyllium venustum* (Fig. 9b) three rows are already established in a group in which two rows are typical. This species also shows other transitional characters bridging the gap between *Catulus torazame* and the Carcharinoidea.

The recent acquisition of the heart of a thirty-foot whale shark, *Rhineodon typus* (Fig. 5), gives an interesting picture of duplication in progress. Here there are two definite rows, the upper membranous and the lower row attached to the upper by chords. Additional pockets are formed on some of the lower valves and between them are two completely formed additional valves. These represent longitudinal multiplication and if later pushed down would form a third row.

*Rhineodon* is a highly specialized shark and externally it possesses such mixed characters that its classification has long been a matter of doubt. In 1930 I described the teeth, denticles, claspers, vertebrae, and certain of the jaw parts and from the combined evidence decided that this shark was a specialized isuroid. The valves of the heart, however, suggest relationship to the lower group, Orectoloboidea. Duplication is more often found in the lower groups, also, since they are frequently in a varying condition with tendencies approaching higher groups. *Rhineodon* is too specialized to be considered in any way transitional, but the duplication is doubtless an expression of this specialization.

The Heterodontea and the Chismopneae have both typically two rows although three occur in some specimens of *Chimaera*. These are groups of low development and ancient origin.

The Squala show variable tendencies even within the species, *Squalus acanthias* (Figs. 3a and 3c) having two rows in some specimens and three in others. This is unusual and may indicate a mutating species. Other species of *Squalus* (Fig. 3g) and *Etmopterus* (Fig. 3e) have four rows, which give the group a most unstable appearance. This is paralleled in other characters and is doubtless an indication of their transitional character.

The Platosomeae and quite possibly the Galea had their origin in the ancestral squaloids. The Platosomeae show extreme duplication of the heart valves reaching six and even occasionally seven rows (Fig. 12).

The condition commonly found among the lower Osteopterygia, and shown by *Ceratodus forsteri* (Fig. 1*i*) may well be carrying on a condition of duplication already well under way among the elasmobranchs.

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TABLE I.—Groups arranged to show relationships based on the number of rows of valves in the bulbous. Genera showing transitional conditions are shown in smaller type. In this characteristic the Hexanchea and the Carcharioidea have shown extreme specialization.

Heart Valves $t_n$			
5-7 Rows			
<u>Platosomae</u>			
4-5 Rows		Hexanchea	
<u>Spualea</u>	3-4 Rows		<u>Odontaspioidea</u>
<u>Spualus</u>	3 Rows		<u>Isuroidea</u>
	2-3 Rows		<u>Galeorhinus</u>
<u>Holocephali</u>			<u>Carcharinoidea</u>
			<u>Callisquillum</u>
			<u>Catulus</u>
<u>Heterodontea</u>	2 Rows		<u>Orectoloboidea</u>
<u>Spualus</u>			<u>Catuloidea</u>

TABLE II.—Heart Valves.

	NUMBER OF ROWS	
CHISMOPNEAE		
<i>Callorhynchus callorhynchus</i> (Fig. 2d)	2	
<i>Chimaera monstrosa</i> (Goodrich)	2	
(Lankester) (Fig. 2e)	3	
ANTACEAE		
Heterodontea		
<i>Heterodontus japonicus</i> (Fig. 2a)	2	
Squalea		
<i>Squalus acanthias</i> (Fig. 3c)	2	
(Fig. 3a)	3	
<i>Pristiophorus japonicus</i> (Garman)	3	
<i>Squalus fernandinus</i> (Fig. 3g)	4	
<i>Etmopterus lucifer</i> (Fig. 3e)	4	
PLATOSOMEAE		
Narcobatoidea		
<i>Narke japonica</i> (Garman)	2	
<i>Narcacion marmoratum</i> (Garman)	3	
Rhinobatoidea		
<i>Rhinobatus percellens</i> (Garman)	4	
<i>Discobatus sinensis</i> (Garman)	4	
Dasybatoidea		
<i>Discus thayeri</i> (Garman)	4	
<i>Pteroplatea altavela</i> (Garman)	5	
<i>Aetobatus narinari</i> (Garman) (Fig. 12a)	5	
<i>Mobula hypostoma</i> (Garman) (Fig. 12f)	6	
<i>Rhinoptera jussieuvi</i> (Garman) (Fig. 12c)	7	

TABLE III.—Heart Valves.

	NUMBER OF ROWS
ANTACEAE	
Galea	
Orectoloboidea	
<i>Orectolobus japonicus</i> (Garman) (Fig. 4f)	2
<i>Chiloscyllium griseum</i> (Fig. 4e)	2
<i>Chiloscyllium indicum</i> (Fig. 4g)	2
<i>Chiloscyllium plagiosum</i> (Fig. 4a)	2
<i>Stegostoma tigrinum</i> (Fig. 4b)	2
<i>Rhineodon typus</i> (Fig. 5)	2
Odontaspoidea	
<i>Carcharias taurus</i> (Fig. 1f)	3
<i>Scapanorhynchus owstoni</i> (Fig. 1g)	3
Isuroidea	
<i>Isurus punctatus</i> (Garman) (Fig. 7c)	3
<i>Carcharodon carcharias</i> (Parker) (Fig. 7f)	3
<i>Vulpecula marina</i> (Goodrich)	3
Hexancha	
<i>Hexanchus</i> (Owen)	4
<i>Heptanchias perlo</i> (Garman)	4
<i>Notorhynchus pectorosus</i> (Garman) (Fig. 1a)	4
	5
<i>Heptanchias maculatus</i> (Garman)	5
<i>Chlamydoselachus anguineus</i> (Garman)	4
(Fig. 1d)	5

TABLE IV.—Heart Valves.

		NUMBER OF ROWS
ANTACEA		
Galea		
Catuloidea		
<i>Halaelurus burgeri</i> (Fig. 8f)	2	
<i>Halaelurus bivius</i> (Fig. 8a)	2	
<i>Parmaturus xaniurus</i> (Fig. 9f)	2	
<i>Pristiurus eastmani</i> (Fig. 8d)	2	
<i>Cephaloscyllium umbratile</i> (Garman)	2	
<i>Atelomycterus marmoratus</i> (Fig. 8b)	2	
<i>Catulus retifer</i> (Fig. 9a)	2	
<i>Catulus torazame</i> (Fig. 9d)		3
<i>Calliscyllium venustum</i> (Fig. 9b)		3
Carcharinoidea		
<i>Triakis scyllium</i>		3
<i>Galeorhinus mustelus</i> (Fig. 10b)		3
<i>Galeorhinus laevis</i> (Fig. 10a)		3
<i>Galeorhinus fasciatus</i> (Fig. 10e)		3
<i>Galeorhinus manazo</i> (Fig. 10d)		4
<i>Galeus glauca</i> (Fig. 7d)	2	
<i>Eugaleus galeus</i> (Fig. 7a)		3
<i>Carcharinus sorrah</i> (Fig. 11d)		3
<i>Carcharinus porosus</i>		3
<i>Carcharinus commersonii</i> (Fig. 11e)		3
<i>Carcharinus milberti</i> (Fig. 11a)		3
<i>Carcharinus acronotus</i>		3
<i>Carcharinus spallanzani</i>		3
<i>Scoliodon wahlbeehmi</i>		3
<i>Physodon mülleri</i>		3
<i>Sphyrna zygaena</i> (Fig. 11c)		3
<i>Sphyrna blochii</i> (Fig. 11g)		3



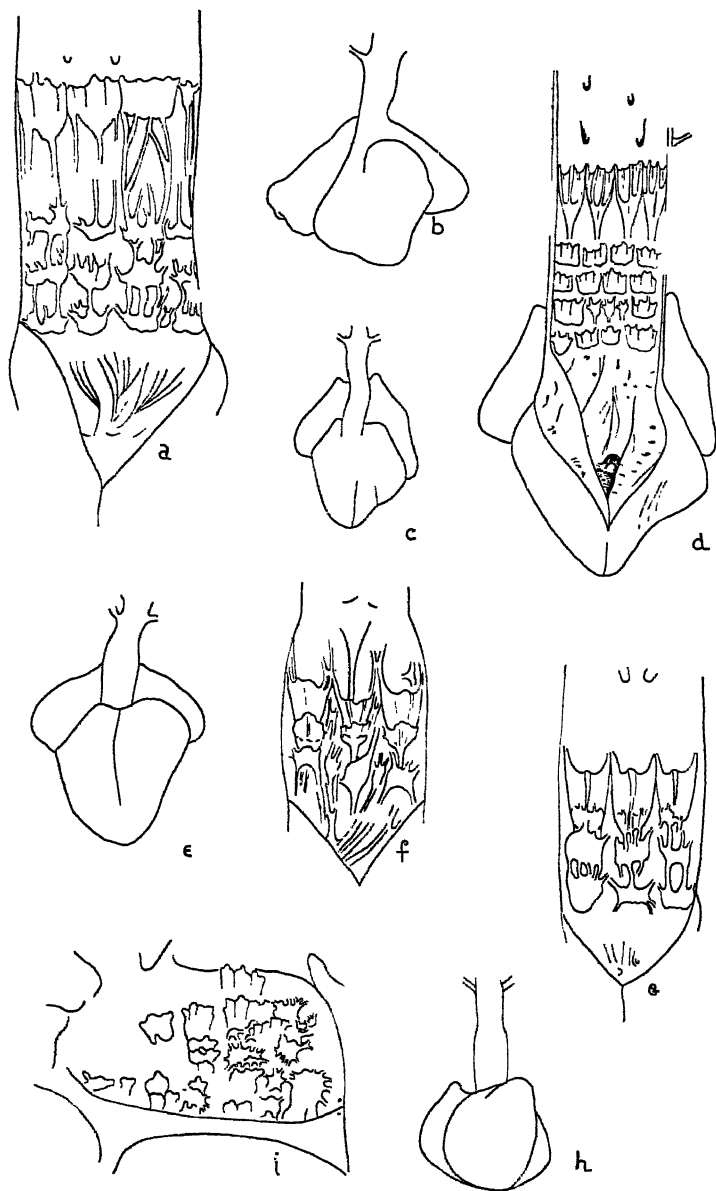


Fig. 1. Hearts and heart valves in the open conus. Note transverse duplication in *f*, *g*, and *i*; and longitudinal duplication in *a* and *d*.

*a* and *b*, *Notorhynchus pectorosus*; *c* and *d*, *Chlamydoselachus anguineus*; *e* and *f*, *Carcharias taurus*; *g* and *h*, *Scapanorhynchus owstoni*; *i*, *Ceratodus forsteri*, after Lankester.

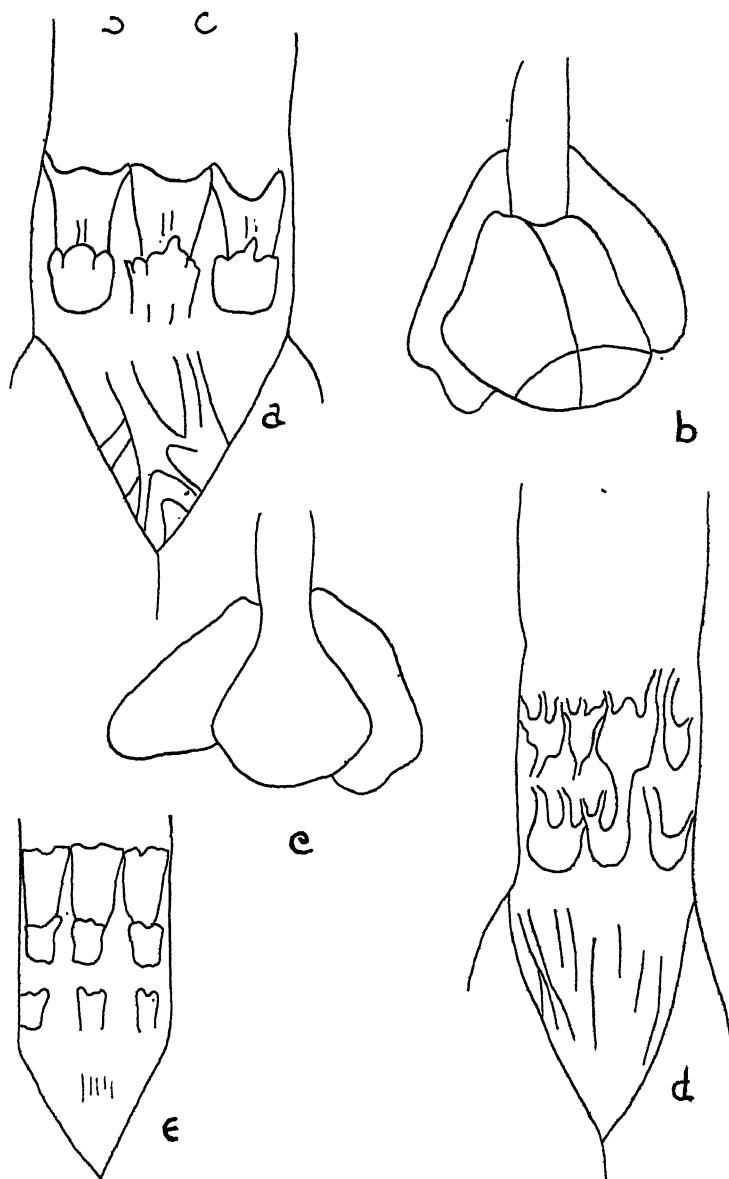


Fig. 2. Hearts and heart valves in the open conus. Note longitudinal duplication in the upper row of *d*.

*a* and *b*, *Heterodontus japonicus*; *c* and *d*, *Callorhynchus callorhynchus*; *e*, *Chimaera monstrosa*, after Lankester.

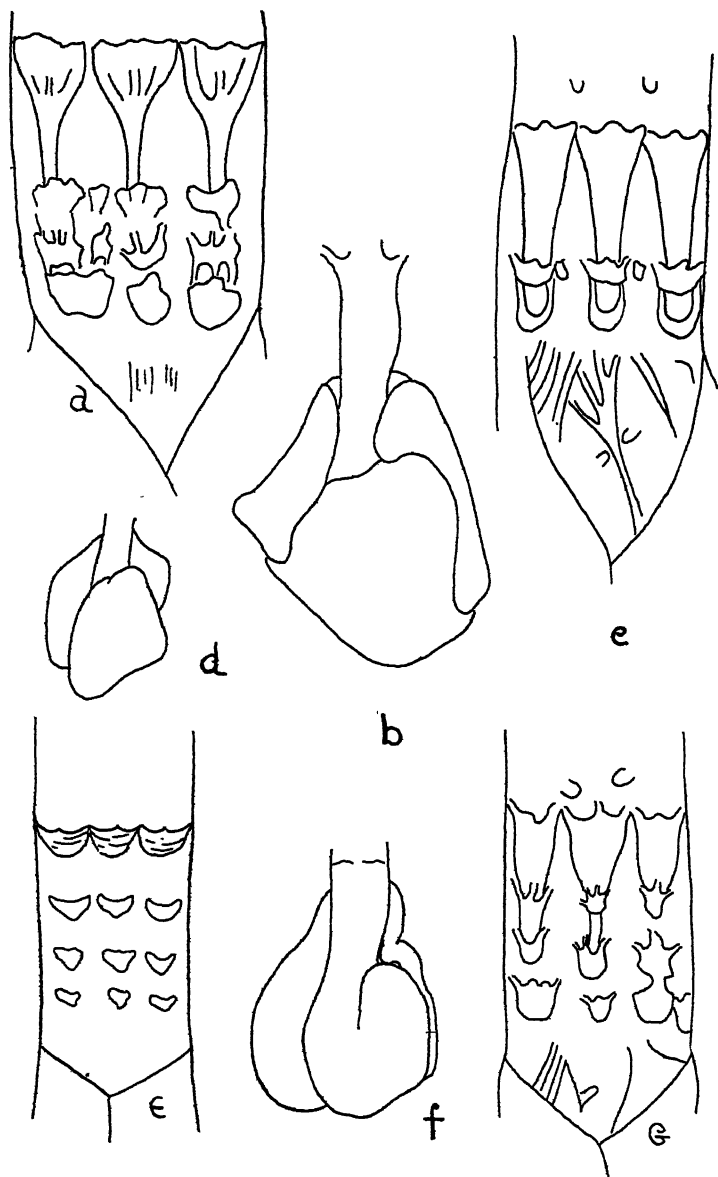


Fig. 3. Hearts and heart valves in the open conus. Note variation in *Squalus acanthias*, and longitudinal duplication in a, c, and g.

a, *Squalus acanthias*, north Atlantic specimen; b, *Squalus fernandinus*; c, *Squalus acanthias*, South American specimen; d and e, *Etmopterus lucifer*; f, *Squalus acanthias*, north Atlantic specimen; g, *Squalus fernandinus*.

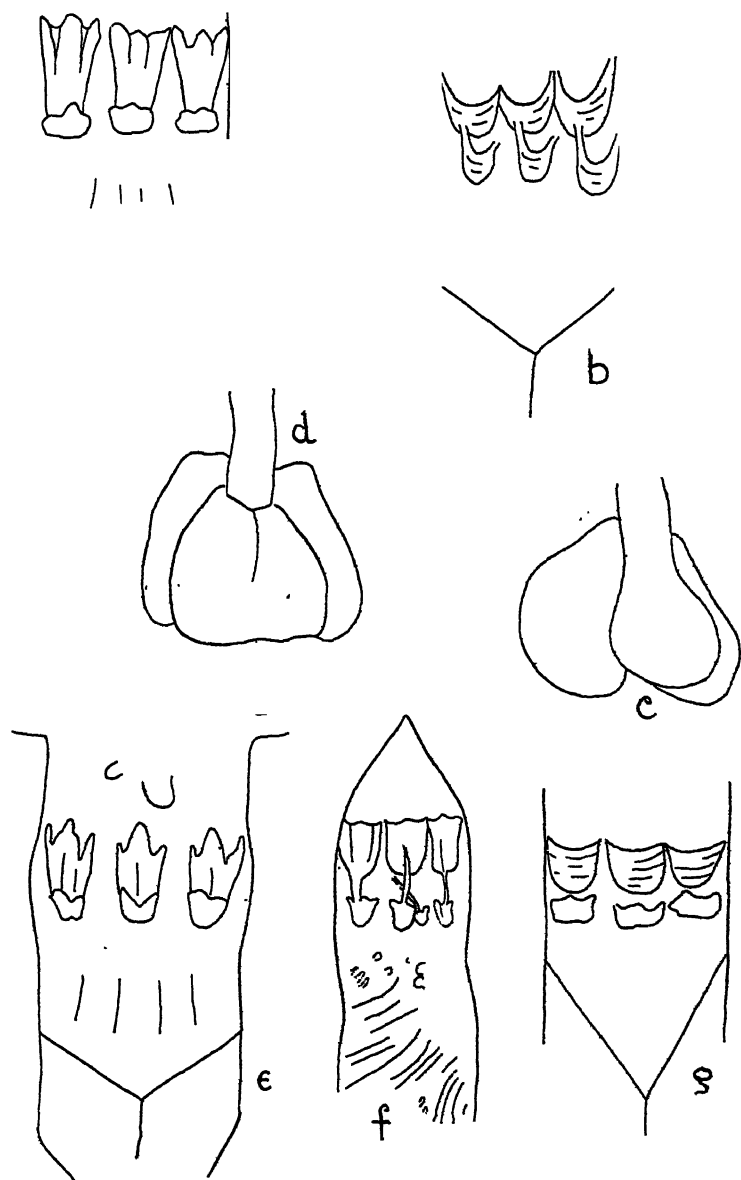


Fig. 4. Hearts and heart valves in the open conus.

a, *Chiloscyllium plagiosum*; b and c, *Stegostoma tigrinum*; d and e, *Chiloscyllium griseum*; f, *Orectolobus japonicus*, after Garman; g, *Chiloscyllium indicum*.



Fig. 5. Conus of heart of *Rhineodon typus*, drawn from fresh specimen. Width of conus opened, 16 inches.

*u*, upper row of valves; *l*, lower row of valves; *a*, accessory valve.



Fig. 6. Photograph of heart of *Rhineodon typus*, open to show valves.

Photograph by A. M. N. H.

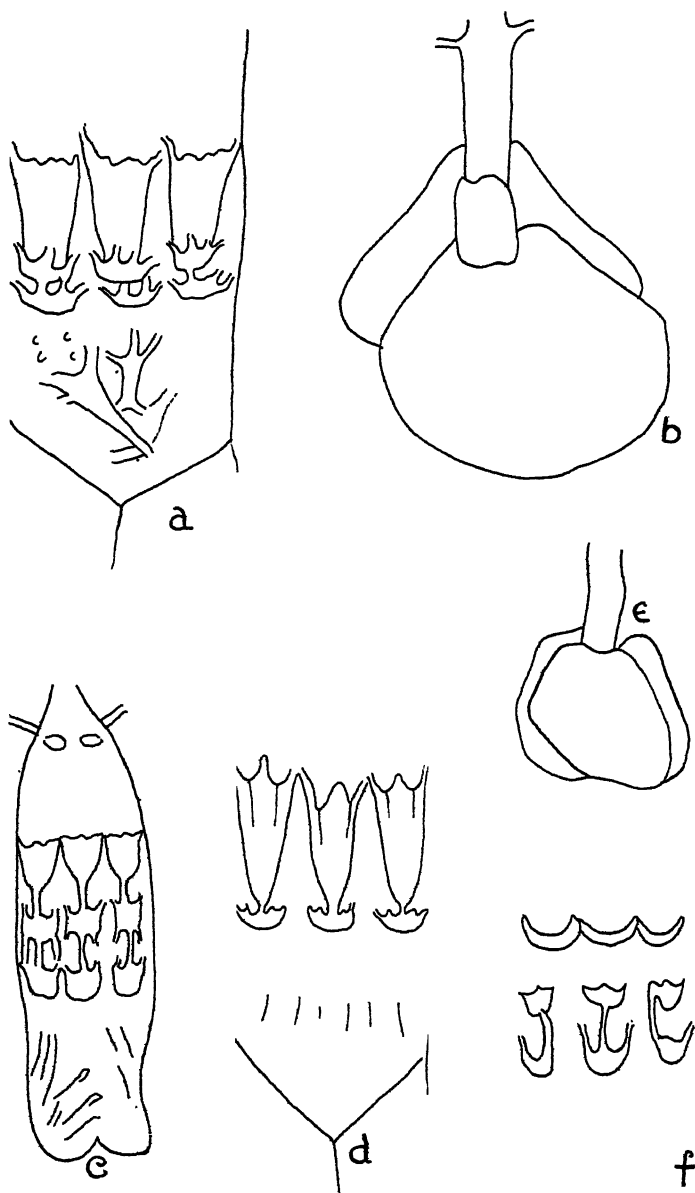


Fig. 7. Hearts and heart valves in the open conus.

a and b, *Eugaleus galeus*; c, *Isurus punctatus*, after Garman; d and e, *Galeus glauca*; f, *Carcharodon carcharias*, after Parker.

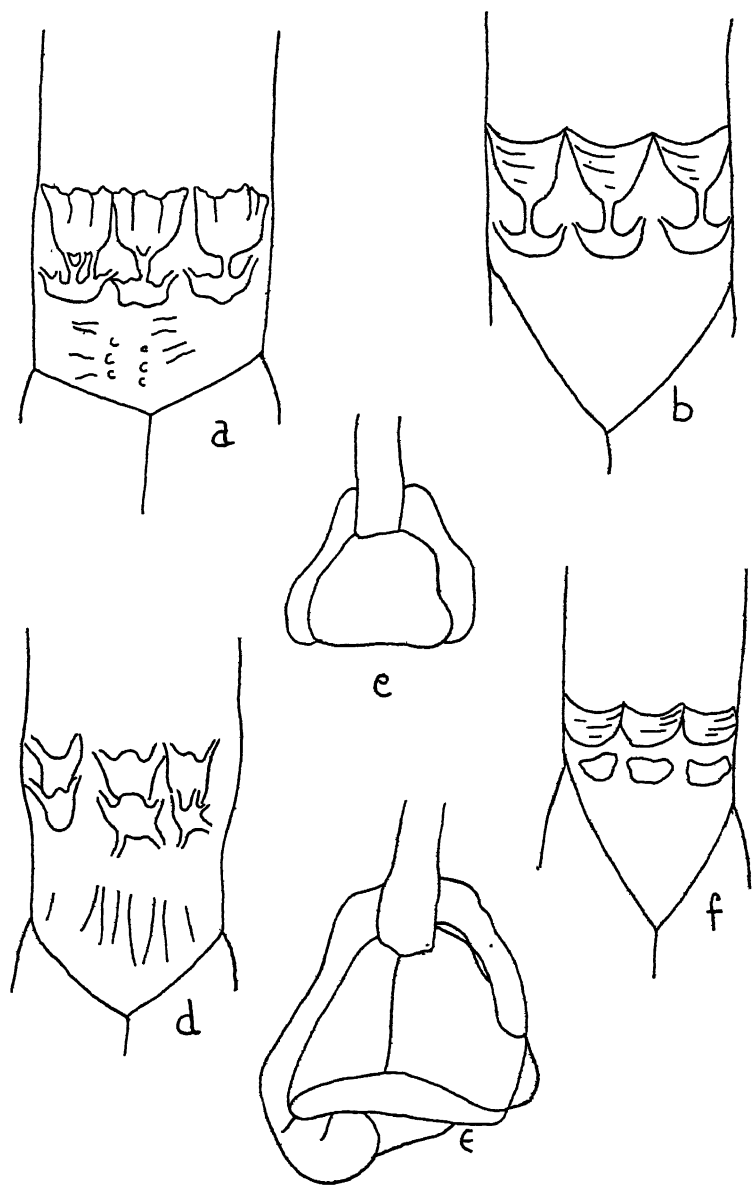


Fig. 8. Hearts and heart valves in the open conus.

a, *Halaelurus bivius*; b and c, *Atelomycterus marmoratus*; d, *Pristiurus eastmani*; e, *Halaelurus bivius*; f, *Halaelurus burgeri*.



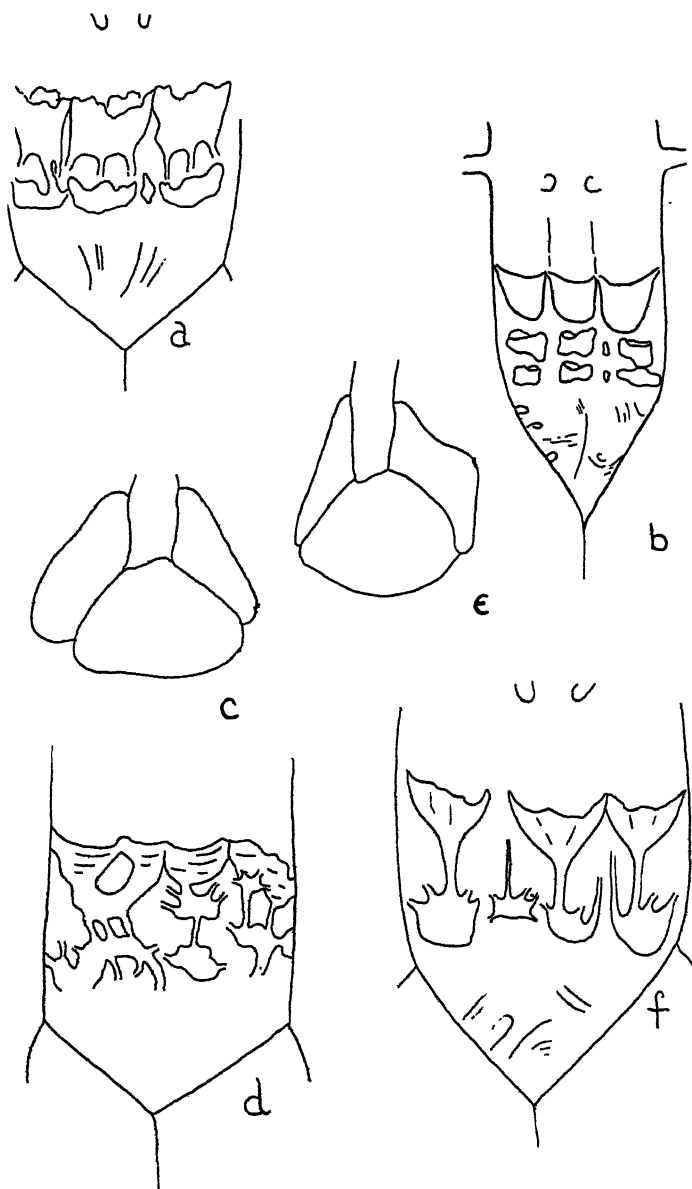


Fig. 9. Hearts and heart valves in the open conus. Note transverse duplication in process in d, and variation of b from the other members of group.

a, *Cotulus retifer*; b, *Calliscyllium venustum*; c and d, *Cotulus torazame*; e and f, *Parmaturus xaniurus*.

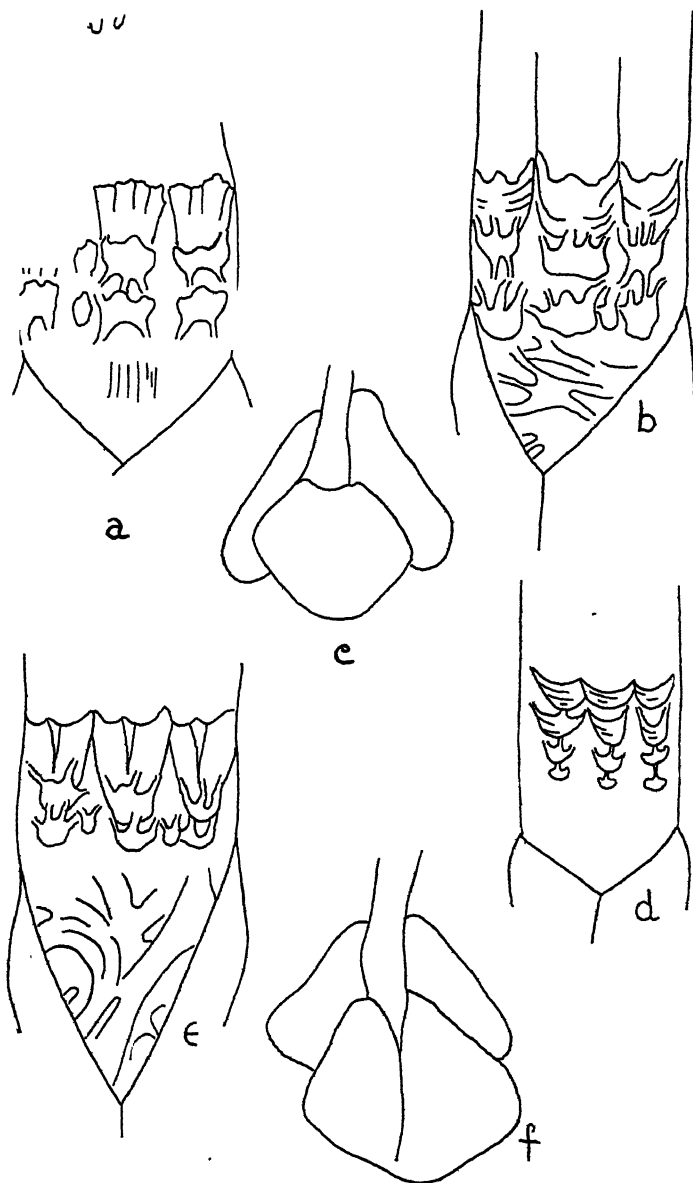


Fig. 10. Hearts and heart valves in the open conus. Note variation in *d*, and the longitudinal duplication in the other species.

*a*, *Galeorhinus laevis*; *b*, *Galeorhinus mustelus*; *c* and *d*, *Galeorhinus manazo*; *e*, *Galeorhinus fasciatus*.

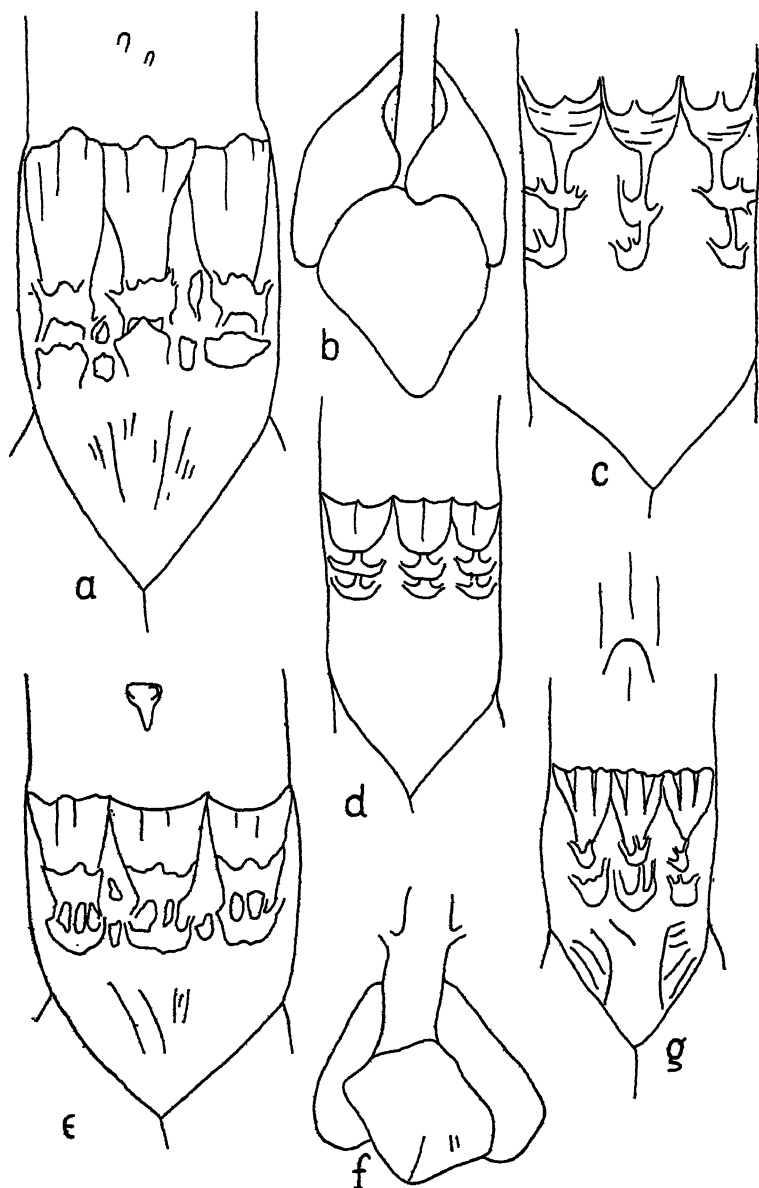


Fig. 11. Hearts and heart valves in the open conus.

a, *Carcharinus milberti*; b, and c, *Sphyrna zygaena*; d, *Carcharinus sorrah*; e, *Carcharinus commersonii*; f, *Carcharinus serrah*; g, *Sphyrna blochii*.

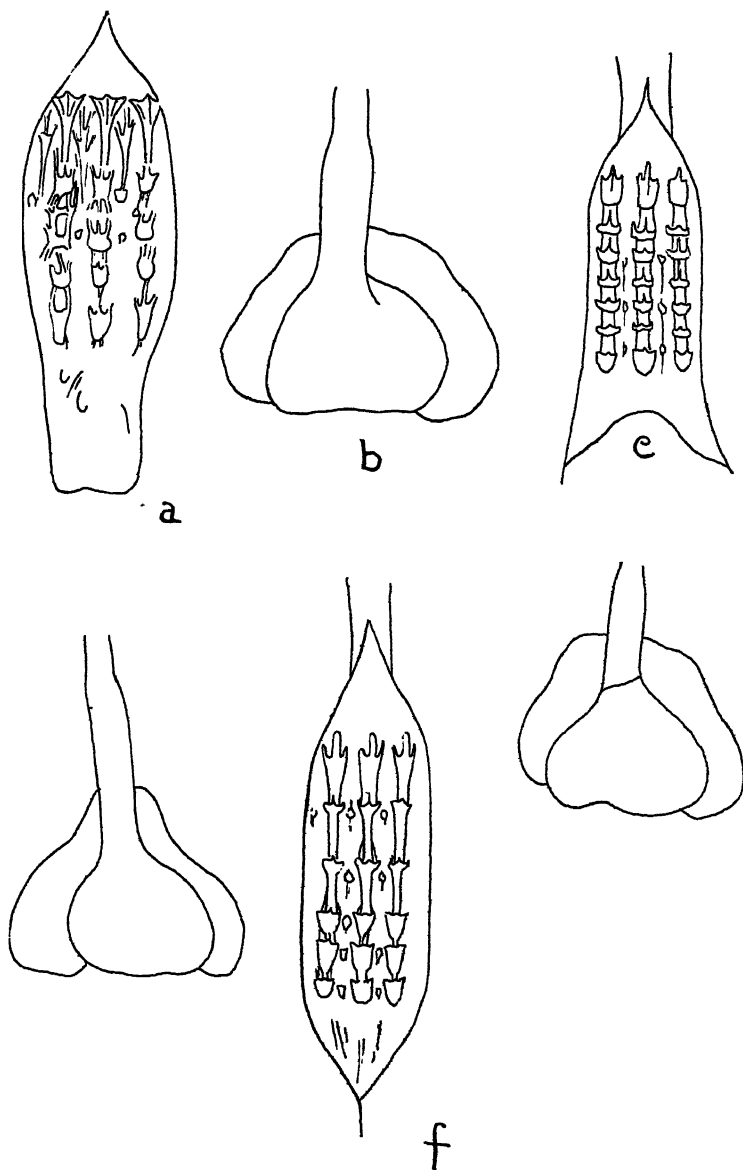


Fig. 12. Hearts and heart valves in the open conus. Note lengthening of the bulbus to accommodate the increased number of rows.

*a* and *b* *Aetobatus*; *c* and *d*, *Rhinoptera jussieu*; *e* and *f*, *Mobula hypostoma*.

All after Garman.



# AMERICAN MUSEUM NOVITATES

Number 839

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

April 10, 1936

## PAGOTHENIA, A NEW ANTARCTIC FISH

BY J. T. NICHOLS AND F. R. LAMONTE

A small collection of fishes brought back by the Second Byrd Antarctic Expedition has been deposited in The American Museum of Natural History. This comprises three species of flying fishes collected at sea; heads of large sea basses and mackerel from the Galapagos Islands; several reef fishes from Easter Island; a single specimen each of *Congiopodus* and *Neptomenus* from New Zealand, peculiar Southern Hemisphere genera rare in collections of the North; and a series of *Pleuragramma antarcticum* Boulenger from the far south, as well as a new genus of nototheniids herein described from the single small specimen obtained. It is planned to report more fully on this material in later Expedition publications.

We are much indebted to Paul Siple of the Expedition staff for his interest in making this material available for study at the American Museum, and his help in securing for us exact data as to the circumstances of its capture.

Specimens were obtained of the two large sea basses of the genus *Mycteroperca* which are common in the Galapagos Islands and usually seen or collected by ichthyologists who visit these waters. They are very closely related, and though they do not look exactly the same, we are unable to point out any significant structural difference between them. In color they are entirely unlike. The color of one is normal—brown with a few markings. As Jenyns not only describes the color of the dried skin on which he based his description but quotes Darwin that the color was “mottled brown,” there can be no question that his *Serranus olfax* was the dark form.

The other is almost uniform strong yellow in life and fades to uniform cream-white in preservative. There can be little doubt that it is on this form that Jordan and Eigenmann based their *Mycteroperca olfax ruberrima*, of which they say:

“A large specimen taken by the Albatross at Abingdon Island, in the Galapagos, seems to have been bright red in life. It probably represents a deep-water variety analogous to the red varieties of West Indian species. It may be distinguished as var. *ruberrima*. The anal is a little

lower than in an equally large specimen of the typical *olfax* taken in the same locality. No other difference is apparent."

The fish is not bright red in life, but as bright red fishes commonly fade to a similar whitish color in preservative, the mistake is obvious. It is not a deep-water variety, but this hypothesis was merely a deduction based on the original error. Just what the relationship between the two forms may be is not known, and it seems least confusing to recognize them as distinct species. We have not seen or heard of an individual alive or dead not readily assignable offhand to the one or to the other.

The two may stand as follows.

***Mycteroperca olfax* (Jenyns)**

*Serranus olfax* JENYNS, 1840, 'Zool. "Beagle,"' Fishes, p. 9, Pl. iv. Galapagos Islands (Coll. Darwin).

***Mycteroperca ruberrima* Jordan and Eigenmann**

*Mycteroperca olfax ruberrima* JORDAN AND EIGENMANN, 1890, Bull. U. S. Fish. Comm., VIII (for 1888), p. 367. Abingdon Isl.

According to Siple, where this and the preceding were caught and seen in great abundance, the two swam intermingled; this one averaged smaller and did not reach so large a size, and was outnumbered by the other ten, or more than ten, to one.

The specimens of *Pleuragramma antarcticum* measuring from 160 to 190 mm. in standard length were mostly from the stomachs of Weddell seals. Siple says:

"The *Pleuragramma* [from seal stomachs] were probably taken at about latitude 78° 34'. However, I have witnessed myself specimens of apparently the same fish having been taken in the stomachs of seals five or more miles south of 78° 35', and in fact, seals occur ten or more miles south of Little America and although we never killed seals this far from camp I am certain that the fish would have been found. There is no reason why the fish do not occur to the southern limits of the Bay of Whales, for they are the major food of the Weddell seal, and wherever cracks appear the seals fill them. There were probably more than 2000 seals in the Bay of Whales and it was common to find their stomach distended with fish apparently of this kind. A seal killed Aug. 19, 1929, had approximately 400 fish in its stomach."

**PAGOTHENIA, NEW GENUS**

Closely related to *Notothenia* Richardson and *Trematomus* Boulenger, but with a single, imperfect, poorly developed lateral line in the center of the peduncular region.

Lower jaw projecting, head compressed, eye large, strictly lateral. Ventrals long and narrow.

TYPE.—*Pagothenia antarctica*, new species.

***Pagothenia antarctica*, new species**

DESCRIPTION OF TYPE.—Number 12973, American Museum of Natural History, from Echo Canyon,<sup>1</sup> approximately lat. 78° 45' S., long. 165° 00' W., November, 1934, by James M. Sterrett. This is presumably the most southerly specimen of a fish ever collected.

Length to base of caudal, 68 mm.; depth in this length, 5; head, 3.4. Eye in head, 3; snout, 3.5; interorbital, 4.5; maxillary, 3; greatest width (back of head), 3; length of peduncle, 3.8; its depth, 3.5; pectoral, 1.2; ventral, 1.1; longest dorsal ray, 2; anal ray, 2.5; caudal, 1.5.

Dorsal V-31; anal, 30; scales about 61.

Mouth oblique, lower jaw distinctly projecting, maxillary to under front margin of eye which impinges on the profile. Nape with a shallow pit, steep in front. Pectorals and ventrals (slenderly pointed with their inner rays the longest) reaching well

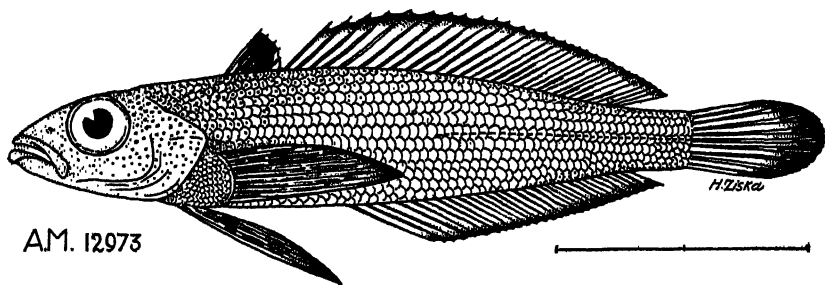


Fig. 1. *Pagothenia antarctica*, type.

past front of anal, the pectorals the farther back. Caudal rounded. Head without scales. No trace of an upper lateral line, the lower (median) lateral line faintly traceable forward to under about the middle of the soft dorsal.

Color in alcohol pale with scattered dark punctulations, largest and most closely spaced about the nape, but nowhere causing definite markings. All fins with dusky tips or edges, the first dorsal black practically to the base between second and fourth rays.

Several of these fishes were observed in life and their color noted as "an iridescent blue like the general color of the crevasse [where they were swimming], some having patches of coral pink near the head."

We have the following field data with this specimen:

"Several of these fish and perhaps others were first seen by Dr.

<sup>1</sup> Echo Canyon is located sixteen miles directly southwest of Little America by dead reckoning. The canyon was formed by a piece of great barrier (250 ft. above the sea) breaking off and drifting out into what was once bay. It froze in this position forming a large ice island. The floor of the canyon is truly bay ice. Through the center of the canyon runs a large tide crack.—Sterrett.



Earle B. Perkins on November 14, 1934, in a seal hole at the above locality. The hole was an opening in a water-filled crevasse about twenty feet deep, six to eight feet wide, and of undetermined length. It was the obvious resting place of seals. The fish retreated to narrow crevices or pockets in the wall of the crevasse when disturbed. They were observed for over an hour and during that time did not swim more than a few feet from their retreats."

The stomach contents of the single individual taken consisted of "about fifty copepods and at least three spindle-shaped diatoms."

There were "two trematodes in the stomach; none on the gills."

We were at first inclined to refer this species to the poorly described *Notothenia phocae* of Richardson, which was taken from the stomachs of seals captured among the ice in Victoria Land at 65° south latitude. But aside from its blue color and being taken among the ice, it shows little agreement with that form.

# AMERICAN MUSEUM NOVITATES

Number 840

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

April 10, 1936

## AFRICAN BEES OF THE GENUS *ALLODAPULA*

By T. D. A. COCKERELL

In 1926 Dr. H. Brauns published a very important paper on *Allodape* (Annals South African Museum, XXIII) in which he described the early stages and commented on the vast number of species inhabiting Africa. Unfortunately he published only a small part of what he knew, and many of his new species, named in manuscript, were published either by short comparative remarks or with regular descriptions by Strand and Friese. It has been customary to credit these to Brauns, and if this is not done, it becomes a difficult matter to decide between earlier brief allusions and later descriptions. In Ann. Mag. Nat. Hist., Aug. 1934, p. 220, I proposed a subgenus or genus *Allodapula*, with *A. variegata* (Smith) as the type. This group not only differs considerably in appearance from true *Allodape*, but the larvae and mode of life are different, as Brauns explained. I now propose to regard *Allodapula* as a genus. It has been stated that the simple hind trochanters of the males distinguish *Allodapula* from *Allodape*. This is generally true, but they are dentate in *A. rufipennis*, which is certainly a good *Allodapula*. *Allodapula* has lateral fleshy protuberances in the larva, quite wanting in *Allodape*. Brauns figures an *Allodape* larva with a dorsal protuberance, but this is not a true generic character, as it occurs also in *Allodapula strandi* (Masi).

In my studies of African *Allodapula*, I had set aside a great series of small species with black abdomen. They look superficially very much alike, but in now dealing with them, I have been able to separate numerous species.

The holotypes of the new forms will all be found in The American Museum of Natural History. All were collected by the Cockerell-Mackie-Ogilvie Expedition of 1931-1932.

### *Allodapula acutigera*, new species

FEMALE.—Length, 7 mm.; black, including labrum, mandibles, antennae (flagellum faintly brownish beneath) and legs, except that small joints of tarsi are red; the hind tarsi have red hair, and that on the hind tibiae is reddish; clypeal mark deep yellow, anchor-like, upper margin concave, lateral descending lobes obtuse, stem narrowing to a point, not nearly reaching apex of clypeus; surface of clypeus dullish

and minutely punctured; tubercles yellow; mesothorax and scutellum polished; area of metathorax dull, with a raised shining margin; hair at sides of thorax dull white; tegulae black; wings hyaline, slightly brownish; stigma large, pale reddish with a dusky margin; nervures brown, first recurrent received far from base of second cubital cell, second nearer apex; abdomen broad, margins of tergites not discolored; tergites 4 to 6 conspicuously roughened; venter with hardly any hair.

Cape Province: Huguenot, Feb. 5-10, 1932 (J. Ogilvie). The clypeal mark is like that of *A. nigrinervis* Cameron and *A. lacteipennis* Brauns. The stigma in *A. nigrinervis* is dark brown; *A. lacteipennis* is a small species with perfectly clear wings. *A. nigrinervis* is very much like *A. gracilis* Bingham.

#### *Allodapula albipennis* (Friese)

Cape Province: Graaff Reinet, Oct. 1931 (J. Ogilvie). Two females, length, 4.8 to 5.3 mm. These agree with Friese's description, except that the mandibles are black. The flagellum is ferruginous beneath; the scutellum, while shining, is finely punctured, not polished like the mesothorax. The first recurrent nervure is near the base of second cubital cell, and the second quite at apical corner. The clypeal mark is a slender band, joined at each end to an equally slender transverse bar; this agrees well with Friese's description, though in a specimen from Grootfontein in the American Museum the vertical stripe is incomplete, the lower half represented only by a spot, and the apical transverse band is lacking.

#### *Allodapula albomaculata*, new species

MALE.—Length, about 4.5 mm.; black, shining, the mesothorax polished, scutellum dull, but showing a shining transverse band when seen from in front; clypeus entirely creamy white, not sulcate, with the usual lateral notches in the white, and small lateral bands next to clypeus, separated from it above the notch by a black line; labrum and large spot on mandibles white; antennae black, with scape white in front; tubercles yellowish white; tegulae hyaline; wings clear hyaline; stigma large, dark brown; nervures pale brown; second cubital cell receiving recurrent nervures near base and apex; basitarsi white, small joints pale red; first tergite shining apically, with a pair of crescentic depressions; the abdomen appears shining under a lens, but dull under a binocular.

Southern Rhodesia: Matopo Hills, April 17-30, 1932 (Alice Mackie). Allied to *A. maurula* (Cockerell) but easily distinguished by the little lateral marks on face, and the much shorter shining dorsal part of first tergite.

#### *Allodapula angolensis* (Cockerell)

Belgian Congo: Tshibinda, Aug. 21-27, 1931 (A. Mackie). Female,

differing from the type by having the second cubital cell much shorter on marginal.

***Allodapula antiquorum*, new species**

FEMALE.—Length about 4.3 mm.; black, shining, the abdomen shining to the end; labrum and mandibles black; tubercles with a narrow light edge; clypeal mark broad at upper end, the upper margin convex, the sides narrowing from the top, converging to a point at lower end of clypeus, the whole mark having the shape of a much elongated kite; clypeus long, produced; mesothorax polished, scutellum finely punctured and dullish; area of metathorax dull, with a shining rim; tegulae pallid, dark at base; wings strongly reddened; stigma dark brown, nervures pale; first recurrent nervure meeting intercubitus a little on outer side, second some distance from end of second cubital cell; legs black; tubercles on first tergite large, shining; tergites without pallid margins.

Southern Rhodesia: Zimbabwe, Sept. 29, 1931 (J. Ogilvie). This is very much smaller than the red-winged *A. rufipennis* from Tshibinda. The red wings and clypeal mark distinguish it from *A. bukaviella* and *A. microsoma*.

***Allodapula bevisi vagans*, new subspecies**

FEMALE.—Length, 4 mm.; agrees with *A. bevisi* (Cockerell) from Natal, in most particulars, but while the front and middle tibiae are bright chestnut red, the hind tibiae are black, red at base and apex. The creamy white clypeus has a black spot on each lateral margin, and a small gray band extends upward from the spot, about halfway up the broad upper portion of the light area. Labrum pale, but mandibles mainly black, reddish in middle; scape with a creamy white stripe, flagellum black; tubercles light; wings clear hyaline, iridescent, with large pale reddish stigma; nervures very pale, first recurrent joining second cubital cell very near base; mesothorax polished, scutellum dull; apex of first tergite with depressions (key-mark).

Belgian Congo: South of Bukavu, Aug. 28, 1931 (L. Ogilvie). I should imagine this to be an individual variation, except for the remote locality. It is easily known from *A. matopina* Cockerell by the black femora.

***Allodapula brunneiventris*, new species**

FEMALE.—Length about 7.2 mm., anterior wing 4.5; black, with the abdomen dark reddish brown, the tergites blacker basally, and with slender pallid margins; clypeal mark yellow, straight above, where it takes the whole width of clypeus, but somewhat above the middle abruptly narrowed to a thick parallel-sided stem; labrum and mandibles black (antennae missing in type); tubercles pale yellow; thorax posteriorly and at sides with dull white hair; tegulae hyaline; base of wings conspicuously light yellow; wings hyaline, beautifully iridescent; stigma large, dark red; nervures light ferruginous; second cubital cell short and high, receiving first recurrent nervure near base, and second not so near apex; mesothorax highly polished, with no median sulcus; scutellum dull; area of metathorax rather short, dull, with a

shining margin; legs black, with the small joints of tarsi red, and middle and hind basitarsi rufescent; hair of hind tibiae and basitarsi silvery white; first tergite with a deep trilobed excavation, the margin posterior to it very narrow, with a pair of small swellings; sternites with outstanding white hair.

Portuguese East Africa: Mozambique, June 6, 1932 (J. Ogilvie). By the clypeal mark, this may be placed near *A. taita* Strand, but it is larger, and the abdomen is quite different. The color of the abdomen suggests the much smaller *A. brunnescens* Cockerell, from South Africa.

***Allodapula bukaviella*, new species**

**FEMALE** (type).—Length, 4.5–5 mm.; shining black, the mesothorax highly polished, scutellum dull, area of metathorax with a shining rim; clypeal mark cream-color or nearly white, varying to a decided yellow, the upper part occupying the whole width of clypeus, the lower part (a little longer than upper part) a broad parallel-sided stem; labrum, mandibles and antennae black; tubercles light yellow; tegulae pale testaceous; wings appreciably dusky, especially apically; stigma dark brown with a pallid streak; nervures brown; first recurrent nervure meeting first intercubitus, second some distance before end of second cubital cell; legs black, including tarsi, which are slightly reddish at extreme end; abdomen broad, shining, the first tergite with weak apical depressions. Many specimens have the clypeal mark reddened by cyanide.

**MALE**.—Length about 4.3 mm.; clypeus pale yellow or distinctly lemon yellow, with the usual notch on each side, but no little lateral marks; labrum light, but mandibles and antennae black; tubercles pale; tegulae dark brown; tarsi black, or middle and hind ones obscurely reddish.

Belgian Congo: Type from Bukavu, August (L. Ogilvie). Many of each sex from Bukavu (J. Ogilvie, L. Ogilvie, A. Mackie, W. P. Cockerell, Cockerell), south of Bukavu (L. Ogilvie, J. Ogilvie) and Uvira (J. Ogilvie). This is larger than *A. minutula* (Fries), which is said to be little shining. The male is very like the South African *A. elizabethana* (Brauns), but is smaller, with light spot on tubercles. The female has the clypeal mark quite different from that of *A. elizabethana*. A male was taken by Miss Mackie at flowers of wild asparagus, south of Bukavu.

The following description of a species from Tshibinda was written under the impression that it could be separated, but close comparisons convince me that it is conspecific, and as the two specimens differ, there is at present no good basis for the diagnosis of a subspecies. The Tshibinda form, from a much higher altitude, might be expected to show racial differences.

**FEMALE**.—Length about 4.5 mm., anterior wing nearly 4; black, including labrum, mandibles and antennae, but tubercles mainly yellow; clypeal mark pale yellow, shaped like a goblet with a broad stem, which is very slightly expanded at the lower end; the junction of the broad upper part with the stem forms an

obtuse angle; the clypeus is flattened, shining, though not polished; mesothorax shining, scutellum entirely dull, area of metathorax dull; under the microscope, the mesothorax is seen to have excessively fine and dense transverse striae, and a very delicate median impressed line on anterior half; tegulae dark brown; wings dilute reddish; stigma dark brown, nervures brown; first recurrent nervure meeting intercubitus, the second some distance from end of second cubital cell; second cubital cell broad above, a little broader than first on marginal; legs black, scopa of hind legs white; margins of tergites not discolored; first tergite with two little swellings near hind margin.

Belgian Congo: Tshibinda, Aug. 26, 1931 (J. Ogilvie). A second specimen, taken at the same place on the same day (L. Ogilvie) has pale grayish wings; I think it is only a variety. It has the first recurrent meeting the intercubitus, as in the type.

This species is very close to *A. pembana* Strand, taken by Voeltzkow on Pemba Island, off the east coast of Africa. It differs only in small details, such as the shining clypeus, and wholly black labrum and mandibles.

I also find that I cannot separate the following females from *A. bukaviella*, though it is possible that when the males are associated with them, some differences may appear.

Katanga: Biano, three (A. Mackie, J. Ogilvie); Tenke, two (Cockerell); Elisabethville, one (Cockerell); Sakania, one (J. Ogilvie).

Tanganika Moco: Niunzu, one (J. Ogilvie); Albertville, two (J. Ogilvie).

Tanganyika Territory: Kigoma, two (J. Ogilvie).

Southern Rhodesia: Matopo Hills, three (J. Ogilvie, A. Mackie).

Transvaal: Wonderboom, near Pretoria, one (L. Ogilvie). In the South African fauna this would fall near *A. maurula*, but it is a smaller species.

#### *Allodapula bulbifera*, new species

FEMALE.—Length about 5 mm.; black, parallel-sided; labrum and mandibles with large punctures, black, the mandibles red subapically; antennae black, the flagellum obscurely brownish beneath, with the sutures black; tubercles broadly margined with light yellow; clypeal mark light yellow, T-like, truncate above, the corners of the lateral arms with downwardly directed points, the stem greatly swollen and bulbous (in outline) above, rapidly narrowing below, slightly broadened at apical margin of clypeus; mesothorax highly polished; scutellum somewhat shining but not at all polished, area of metathorax moderately shining; tegulae brown; wings dusky; stigma large, dark reddish brown; first recurrent nervure meeting intercubitus, second some distance from end of second cubital cell; legs black; abdomen parallel-sided, shining throughout, first tergite with a conspicuous depression on each side of the middle.

Southern Rhodesia: Vumba, Umtali, May 23–26, 1932 (Alice

Mackie). Among related species, it is distinguished by the swollen upper part of stem of clypeal mark. The shape of the abdomen suggests *A. durbanensis*, but that is quite differently marked and sculptured.

***Allodapula convexa*, new species**

FEMALE.—Length about 4.5 to 5 mm.; black, including labrum, mandibles and antennae, but tubercles with a yellow spot; clypeal mark anchor-like, with a rather thick stem, the upper margin strongly convex (rounded), the arms directed downward in hook-like fashion; mesothorax highly polished, scutellum shining but not polished; tegulae brown; wings strongly brownish; stigma dusky red; second cubital cell receiving first recurrent nervure near base, second more remote from apex; legs black; abdomen shining throughout; tubercles of first tergite well developed.

Belgian Congo: south of Bukavu, Aug. 28, 1931, two (J. Ogilvie). Among the similar females it is readily known by the anchor-like clypeal mark, strongly rounded above. The shape of the clypeal mark at once separates it from *A. rufipennis*.

***Allodapula debilitata*, new species**

FEMALE.—Length about 4.5 mm.; robust, black, including labrum, mandibles, scape and tubercles; flagellum faintly brownish beneath; clypeus long, shining, the pale mark creamy white, T-like, with very slender stem and transverse bar (the upper edge of which is very slightly concave), in one specimen the stem broken, the lower end represented by a small spot; mesothorax highly polished; scutellum dullish, shining anteriorly; area of metathorax moderately shining, with a dull central depression; tegulae pallid, translucent; wings clear hyaline, somewhat milky; stigma large, dark brown, with a paler streak; nervures brown; second cubital cell receiving recurrent nervures not far from base and apex; legs black, with white hair, the tarsi rufescent apically; abdomen with first three tergites shining, the others dull, with shining margins; first tergite without evident tubercles.

Southern Rhodesia: Matopo Hills, April, three (A. Mackie, J. Ogilvie). Among related females, it is known by the very slender face-marks, rather milky wings and black tubercles. It is near to *A. albipennis* Friese, but differs by the slender and quite differently colored stigma, black tubercles, etc.

***Allodapula diloloensis* (Cockerell)**

Belgian Congo: Kabalo, Aug. 15 (J. Ogilvie); Biano, Aug. 8–11 (L. Ogilvie). Females, with the clypeal mark a little different from that of the type, but not to be separated.

***Allodapula durbanensis*, new species**

FEMALE.—Length about 5.4 mm.; robust, parallel-sided; black, including mandibles and scape, but labrum pallid, and tubercles with a pale margin, flagellum obscurely reddish beneath; clypeal mark creamy white, T-like, with a long slender

stem, and a short rather thick transverse bar; mesothorax highly polished; scutellum large, entirely dull; area of metathorax dull; tegulae brown, with pallid margin; wings clear hyaline but not milky; stigma dusky reddish, the margin darker; nervures brown; second cubital cell very broad above, receiving recurrent nervures near base and apex; legs black, the tarsi rufescent at end; abdomen thick, parallel-sided, tubercles of first tergite distinct. The posterior part of mesothorax, beyond the obtuse transverse ridge, is finely lineolate, and shows a series of large round shallow pits; the scutellum also has such pits, mostly on the anterior part; the area of metathorax is not defined, it is finely transversely lineolate, with an irregular surface, and scattered pits.

Natal: Durban, October 1931 (J. Ogilvie). In a key to similar species, it runs next to *A. rufitarsis*, but it is larger, with darker stigma, and especially distinguished by the sculpture of the thorax.

#### *Allodapula flavibasis*, new species

FEMALE.—Length about 6 mm.; black, including mandibles, labrum and antennae, but tubercles apically yellowish white; clypeus black, except the upper end, which has a transverse yellow band, broad at sides, but on its lower margin with a pair of rounded incisions (invasions of the black surface), so that the band may be said to be trilobed below; clypeus long, flat, shining; mesothorax polished; scutellum large, dull; area of metathorax dull; thorax posteriorly and at sides with dull white hair; tegulae dark brown; wings brownish hyaline; stigma uniform dusky reddish; nervures pale reddish; second cubital cell not so long on marginal as first; recurrent nervures joining second cubital cell about equally distant from base and apex; legs black, with small joints of tarsi red; hind tibiae with copious silvery white hair; abdomen broad, the first three tergites shining, the margins of tergites narrowly brownish; first tergite with a pair of prominent bosses near hind margin.

Belgian Congo: Niunzu, Sept. 2 (J. Ogilvie). By the clypeal mark this resembles *A. lacteipennis* Brauns (the form called *basizona* Friese), but it is much larger and more robust, with differently colored wings.

What I suppose to be the male of this is represented by a specimen with the same data. The clypeus is yellow (reddened by cyanide), the yellow with a deep constriction on each side below the middle, but no little lateral marks; the upper side of the mark is gently concave; labrum with a large light spot, but mandibles black, rufescent sub-apically; scape yellow in front; flagellum dusky reddish beneath; tubercles with a yellow crescent; tarsi clear ferruginous. Length about 6 mm. This agrees in large part with the description of male *A. taita* Strand, but that has little yellow marks at each side of clypeus, after the manner of *A. albomaculata*, *A. melanosoma* and *A. rufitarsis*. The female is not like *A. taita*.

Another male *A. flavibasis*, with conspicuously reddish wings, comes



from Elisabethville, September (J. Ogilvie). It is easily known from *A. rufipennis* by the light tarsi and light stripe on scape.

***Allodapula flavolateralis*, new species**

MALE.—Length about 4.3 mm.; black, head very large and broad, with very large eyes; clypeus pale lemon yellow, the light area very broad above, the upper margin gently concave, the sides gently rounded; the median constriction, rather below the middle, is deep, and there are no adjacent lateral marks; the lower part is very broad, like a reversed shallow cup, the lateral margins appearing elevated; under the microscope it is seen that the sides of lower part of clypeus are actually bordered by narrow lateral marks, which have the effect of broadening the lower part of clypeal mark (the type male of *A. maurula* also has such appended marks, but not so well developed, and only evident under a high power of the microscope); mandibles black, a little rufescent apically (they are yellowish white in *A. grandiceps* Friese); labrum yellow; scape yellow in front; flagellum entirely dark; mesothorax and scutellum polished, but the latter a little roughened; tubercles yellow; mesopleura shining but well punctured; tegulae hyaline, with a yellow spot; wings dusky, stigma rather dark brown, nervures dark brown; second cubital cell rather narrow above, receiving first recurrent nervure a considerable distance from base, and the second somewhat nearer apex; legs black, with pallid, somewhat reddish, tarsi; abdomen ordinary, very stout, appearing faintly brownish in contrast with the polished black of the thorax; first tergite with the usual submarginal tubercles.

Cape Province: Uitenhage, Oct. 1931 (A. Mackie). Related to *A. maurula* Cockerell, but certainly distinct by the lemon-yellow clypeal mark, the upper part of which is much broader, and the lack of light spots on the mandibles. The large head and general appearance seem to make it unlikely that it is the male of *A. luckhoffi*.

***Allodapula foveata* (Smith)**

I examined Smith's type (from Sierra Leone) in the British Museum. It is about 7 mm. long; clypeus with a broad band, hard to see, as the specimen seems to have been in alcohol; hind tibiae and tarsi with long dull white hair; antennae black; tergites narrowly reddish margined; first tergite with a deep quadrate basal depression. Friese recorded it from Kilimanjaro, but I have a female of this lot, and it is a different species.

***Allodapula gorillarum*, new species**

MALE.—Length about 4.3 mm.; black, including labrum, mandibles and antennae, but tubercles with a slender yellowish-white crescent; clypeus with a broad yellowish-white longitudinal band, constricted at sides well below the middle, the part below the constriction broadened, its lower end truncate; the upper part of the band widens slightly to the truncate upper end, but the whole effect is that of a broad band, the details described being only noticeable on close inspection; mesothorax

and scutellum shining, area of metathorax dull; tegulae very dark brown; wings brownish hyaline; stigma dark brown, nervures brown; first recurrent nervure meeting intercubitus (as in *A. progenia* Strand), the second joining second cubital cell a little before the end; second cubital cell very broad above; legs black; abdomen ordinary, two tubercles near hind margin of first tergite.

Belgian Congo: near Tshibinda, Aug. 24, 1931 (J. Ogilvie). This was taken on the excursion with the pygmies to the haunts of the gorilla, and came from an altitude higher than Tshibinda. In the tables it runs near the female of *A. elizabethana* Brauns, which has a much more slender clypeal band, but it is very unusual for a male to have a median band.

#### *Allodapula hamatifera*, new species

FEMALE (type).—Length about 6.5 mm., anterior wing 4.5; black, including labrum, mandibles, antennae and tubercles; clypeus with a creamy white (turned pale brownish by cyanide) T-like mark, the upper margin straight, the transverse upper part a rather narrow band, produced and hook-like at the posterior lateral corners; the stem long (the clypeus being quite long), slender, usually with a distinct swelling in its upper part; frontal keel very strong; hair of thorax dull white; mesothorax polished, scutellum entirely dull; area of metathorax shorter than usual, dull, with a shining margin; tegulae very dark, slightly brownish; wings dusky hyaline; stigma dusky brownish with a darker margin; marginal cell on first cubital cell at least as broad as on second; second cubital cell receiving recurrent nervures near base and apex; tarsi somewhat reddish at tips; hair of legs white (collecting bright orange pollen); abdomen broad, margins of tergites very narrowly, inconspicuously, pallid; first tergite near apical margin with a pair of elevations; sternites 2 to 4 with very bright white hair, but on apical part of venter it is pale grayish.

MALE.—Length about 5 mm.; mandibles, antennae and tubercles black; labrum with a very small light spot; clypeal mark joined to a broad transverse apical band; legs dark as in female.

Southern Rhodesia: type from Vumba, Umtali (J. Ogilvie). Fifteen females and one male from Vumba and Christinas Pass, Umtali, May (J. Ogilvie, L. Ogilvie, A. Mackie).

The female may be compared with related species thus:

1. Broad part of clypeal mark quadrate, not greatly shorter than stem. . . . . *taia* Strand.  
Broad part of clypeal mark a transverse band, much shorter (anteroposteriorly) than stem. . . . . 2.
2. —Stem broad, its upper part expanded, and more than half as wide as clypeus.

*diloloensis* Cockerell.

Stem narrow, less than half as wide as clypeus. . . . . *hamatifera* Cockerell.

From all the above, *A. elizabethana* Brauns is distinguished by being smaller, the clypeus with a longitudinal pale line. The female of *A. hamatifera* must also be very similar to *A. T-insignita* Strand, but not the same.

The male *A. hamatifera* is close to *A. angolensis* Cockerell, differing

by being smaller, with a much smaller spot on labrum, clypeal mark with apical band meeting stem at a right angle, and second cubital cell not nearly so broad above. The male also appears to be allied to *A. rolini* Vachal.

From Tanganyika Territory: Kigoma, August (J. Ogilvie), and Ujiji (Cockerell, A. Mackie, J. Ogilvie) come numerous females of *A. hamatifera*, differing slightly in that the upper part of the stem of the clypeal mark shows no swelling.

One female, having the second recurrent nervure much more remote from end of second cubital cell than usual, is from Kabalo, Belgian Congo, August 15 (J. Ogilvie). A male is from Niunzu, Belgian Congo (120 kilom. east of Kabalo), September 2 (J. Ogilvie). In Katanga, three females were taken at Tenke, July–August (L. Ogilvie, J. Ogilvie), one at Bianco, August (A. Mackie), four at Sakania, September (A. Mackie, J. Ogilvie), and nine at Elisabethville, September (L. Ogilvie, J. Ogilvie, Cockerell). These Katanga specimens are somewhat variable; four from Elisabethville and one from Sakania have the tubercles narrowly edged with yellowish white. In a species with such a wide range, local races are to be expected, but I cannot clearly define any at present.

The following females, referred here, are not typical:

- (1) Smaller, about 6 mm. long, wings dusky hyaline. Matopo Hills, Southern Rhodesia, five (C. P. Harvey, A. Mackie).
- (2) Smaller, about 5.5 mm. long, wings darker, decidedly brownish. Kafubu Mission, Katanga, two (L. Ogilvie).

#### *Allodapula innata*, new species

**FEMALE.**—Length about 5.3 mm.; black, with all the tibiae and tarsi bright chestnut red (the front tibiae have a dusky stripe on outer side), the knees also narrowly red and a red stain on hind trochanters and base of femora in front; scape black, with a light spot at each end; flagellum obscurely brownish beneath toward apex; clypeal mark clear light yellow, having the outline of a goblet with a thick stem, the constriction oblique, not angular; labrum obscurely reddish; mandibles black; tubercles light yellow; tegulae dark brown, pallid posteriorly; wings clear hyaline; stigma large, sepia brown; nervures rather pale brown; second cubital cell receiving first recurrent nervure some distance from base, and second nearly as far from apex; mesothorax highly polished; scutellum dullish; first tergite with a broad median depression; hind margins of tergites not distinctly reddened; hair of hind tibiae silvery white.

Southern Rhodesia: Matopo Hills, April 17–30, 1932, three females (A. Mackie, L. Ogilvie). This is the type locality, but there is also one from Louis Trichardt, Transvaal, April 4–10 (A. Mackie). Two females

are from Umtali (Vumba and Christmas Pass), Southern Rhodesia, May (J. Ogilvie); one is from Shangani, De Beer's Ranch, May (J. Ogilvie); one from Victoria Falls, Sept. (L. Ogilvie). I have three males which I must refer to this species, as they seem to differ only in the usual sexual characters. The clypeus is all light except a notch on each side; the scape has an entire light band in front; the hind femora are obtusely subangular below. One of these is from the Matopo Hills (A. Mackie); the other two, with somewhat broader face, are from Lubumbashi, Katanga, July 22, 1920 (Michael Bequaert).

Related to *A. claripes* Friese, but distinguished by the polished mesothorax. *A. citrifloris* Cockerell is smaller, the clypeus yellowish white, scape light in front, a light spot on mandibles.

#### *Allodapula kivuensis*, new species

FEMALE.—Length about 6 mm., anterior wing nearly 5; black, including antennae, labrum and mandibles, but tubercles broadly margined with deep yellow; clypeal mark T-like, yellow (reddened by cyanide in type), the stem moderately broad, the upper (transverse) part short, and sloping to the stem; clypeus not at all grooved; mesothorax shining; scutellum dull, moderately shining but not polished on disc; area of metathorax somewhat shining; mesopleura dullish, with dense small punctures; tegulae dark brown; wings strongly brownish, stigma and nervures dark brown; legs black, hind legs with copious white hair; abdomen with first three tergites shining; first tergite with two longitudinal depressions; venter with pure white hair.

Belgian Congo: Lake Kivu, at Bukavu, Aug. 20, 1931 (T. D. A. Cockerell). Resembles *A. taita* Strand, but easily separated by the brownish wings, and the much shorter broad part of the clypeal mark. The wings suggest *A. rufipennis* from Tshibinda, but that has quite a different clypeal mark, and the tubercles are black.

#### *Allodapula krugeri*, new species

FEMALE.—Length about 4.3 mm.; black, the labrum obscurely brownish, mandibles red apically; scape black, flagellum obscurely brownish beneath; tubercles with a light margin; clypeal mark T-like, straight above, lateral arms short, with points directed downward, stem rather thick; mesothorax polished, with a deep circular fovea in the middle; scutellum moderately shining, but not polished, minutely granular, with scattered very small punctures; area of metathorax entirely dull; tegulae brown; wings dusky; stigma rather light red, nervures all very pale reddish; second cubital cell narrow above, receiving first recurrent nervure at basal corner, second some distance from end; legs black; abdomen broad, shining throughout.

Transvaal: Kruger National Park, Oct. 1931 (J. Ogilvie).

There are three kinds of minute females, which at first I regarded as one species, but they are readily separable thus:

- 1.—Nervures all pale, stigma pale reddish, mesothorax with a fovea in middle.

*krugeri*, n. sp.

Nervures darker, mesothorax without a fovea.....2.

- 2.—Wings pale grayish; clypeal mark with a long rather slender stem. *rhodesi*, n. sp.

Wings reddish; clypeal mark with a shorter, broader stem.....*pusilla*, n. sp.

*A. krugeri* has the small size and light stigma of *A. microsoma*, but the clypeal mark is quite different.

### *Allodapula lacteipennis* (Brauns)

Cape Province: Calvinia, two females, Nov. 11–16, 1931 (A. Mackie). One has a slender transverse white line at top of clypeus, and the tubercles with a slender white crescent; in the other the face and tubercles are entirely black. In a series of nine females from Blaukrans, near Calvinia (Cockerell, W. P. Cockerell, J. Ogilvie) the face is entirely black, and only two show traces of light color on tubercles. Friese describes the face of female *A. lacteipennis* as all black; my specimens from Brauns show the white band at the top of clypeus. The type locality is Willowmore.

Two females from Van Rhyn's Pass (L. Ogilvie, Cockerell) have the face all black. A female from Doorn River Falls, Nov. (Cockerell), has some very minute light marks at upper edge of clypeus.

### *Allodapula littoralis*, new species

FEMALE.—Length about or nearly 6 mm.; black, with red legs and yellow tubercles. It closely resembles *A. pulchripes* Cockerell, but differs thus: clypeal mark clear light yellow, the sides of the broad stem (or lower half) bulging; mandibles red in middle; scape with a slender yellow line; scutellum entirely dull; stigma reddish brown; front trochanters largely black; front femora broadly black behind, and on basal half in front. The first recurrent nervure joins second cubital cell a considerable distance from base, but second almost at apex. The first tergite has a pair of longitudinal depressions.

Portuguese East Africa: Mozambique, June 6, 1932 (J. Ogilvie).

### *Allodapula luapulana*, new species

MALE (type).—Length, 4–4.3 mm.; black, shining, but the apical tergites dullish, with polished margins; mandibles with a very large subtriangular yellow spot; labrum with a large pale spot; antennae black, the flagellum very faintly brownish beneath; clypeal mark lemon yellow, consisting of an upper subquadrate broad part, its upper margin straight, its sides gently convex, with tooth-like downward projections, but these contiguous with the rest of the mark; in the middle the mark is deeply constricted to about half the diameter of the upper part, narrowest where it joins the lower (apical) part at a very acute angle, the apical part being a very broad transverse band; thorax at sides and posteriorly with much dull white hair; tubercles with a yellow margin (all black in a second specimen); mesothorax highly

polished; scutellum shining but punctured, polished in middle of disc; area of metathorax dull; tegulae very dark brown; wings conspicuously brownish; stigma dark reddish brown, nervures brown; second cubital cell receiving first recurrent nervure very near base, second not so near apex; legs black, with small joints of tarsi red; first tergite with small tubercles.

FEMALE.—Length about 4.3 mm.; labrum and mandibles black; tubercles with a narrow light edge, or all black; clypeal mark like a T with a very long narrow parallel-sided stem, the transverse bar also narrow, a little arched above, descending and more or less hooked at ends; scutellum duller, not polished in middle; wings conspicuously brownish.

Belgian Congo (Katanga): Tenke, July–August, two of each sex (Cockerell, A. Mackie, L. Ogilvie). The female is related to *A. antiquorum*, but the face-mark is quite different. The male suggests *A. wilmattae*, but it is much smaller.

There is also a female *A. luapulana* from Bianco, Aug. (A. Mackie). The tubercles are black. A female from Katanga Mission, Sept. 17 (J. Ogilvie) has the tubercles broadly yellow. One from Dilolo, July (W. P. Cockerell) has a yellow crescent on tubercles. It is rather large, over 5 mm. long.

#### *Allodapula lucidula*, new species

MALE.—Length about 4 mm., like *A. elizabethana* Brauns, but distinguished by the much paler stigma and white face-marks. I was almost ready to consider it the undescribed male of *A. longula* (Friese), but the tegulae are dark brown; in *longula* white with a brown spot. The labrum has a large pale spot, but the mandibles and antennae are black. The scape of *A. lacteipennis*, according to Friese, is white in front in the male, otherwise I might have thought *A. lucidula* the male of *lacteipennis* (agreeing in the clear wings and light stigma), of which I possess only the female. The clypeus is not all concave or grooved, as it is said to be in *A. pembana* Strand and *A. minuta* Friese. Other salient characters are: tubercles black; mesothorax and scutellum polished all over, and area of metathorax moderately shining; legs black, the basitarsi brownish, the small joints of tarsi light reddish; first recurrent nervure meeting intercubitus, second some distance from end of second cubital cell.

Cape Province: Van Rhyn's Pass, Nov. 11–21, 1931 (T. D. A. Cockerell).

#### *Allodapula luckhoffi* (Cockerell)

Cape Province: Uitenhage, four females (A. Mackie, L. Ogilvie).

Southern Rhodesia: Matopo Hills, two females, April 17–30 (A. Mackie). These have the head more elongated (clypeus more produced) than in the typical form.

This species is readily separated from numerous similar females by the polished scutellum and the concave upper margin of clypeal mark.

*Allodapula luckhoffi microsoma*, new subspecies

FEMALE.—Length, 4 mm.; black, shining; labrum light red; mandibles black; clypeus with an anchor-shaped very pale yellow mark. The upper margin concave, the narrow lateral arms (at upper end of clypeus) each with a hook-like point directed downward, the stem slender, rapidly narrowing to a line, its length variable; scape with a small light spot near base, flagellum pale dusky brown beneath; tubercles with a narrow light edge; mesothorax, scutellum and mesopleura polished; area of metathorax dullish, not at all polished; tegulae pale brown; wings clear hyaline, iridescent (but not appearing milky); stigma pale sepia throughout; nervures very pale brown; second cubital cell narrow above, receiving first recurrent nervure a considerable distance from base, the second nearer apex; legs black, dusky reddish at end, but the basitarsi dark; abdomen with the first three tergites shining, the apical tergites conspicuously hairy; first tergite broadly shining dorsally, without evident tubercles.

Cape Province: Graaff Reinet, Oct. 1931 (Alice Mackie, J. Ogilvie). This is a sort of small edition of *A. albipennis* Friese, from southwestern Africa, but that is not only larger but has the wings milky and the stigma very pale (specimen from Windhoek examined). It is also related to *A. lacteipennis vernayi* Cockerell, but much smaller, with darker stigma. The polished scutellum, and position of first recurrent nervure, distinguish it from certain species of Central and East Africa.

*A. luckhoffi microsoma* was also collected at Oudtshoorn, Oct. 1931 (T. D. A. Cockerell). I had separated this from *A. luckhoffi*, also found at Graaff Reinet, on account of its small size. It probably breeds in smaller stems, but I am now uncertain whether it is really a different species, or a result of poorer nutrition. Some authors argue that a species cannot have a subspecies in the same locality, but this may not apply to bees, which can be segregated by their different modes of life. I find that in many parts of Africa the local *Allodapula* can be segregated into larger and smaller forms or species, and it is not certain whether the small species are most related to one another, or to the larger species occurring in the same regions.

*Allodapula matopina*, new species

FEMALE.—Length, 4.6–5.3 mm.; black, mostly shining, but although the mesothorax is highly polished, the scutellum is dull; hair of thorax very scanty, white; clypeus yellow with the light mark constricted on each side, the outline like that of a goblet with a very broad saucer-like base; labrum red; mandibles red in middle; scape with a pale stripe; flagellum black, faintly brownish beneath apically; area of metathorax dull, with a shining rim; tubercles pale yellow; tegulae very small, testaceous; wings hyaline; stigma large, reddish with a darker margin; nervures rather light brown; second cubital cell short, receiving recurrent nervures about equally distant from, and quite near, base and apex; legs bright chestnut red, the coxae, and front trochanters in part, black; hair of hind legs shining silvery; ab-

domen broad, the basal half shining; first tergite with a pair of depressions, the key-like marking of Strand.

Southern Rhodesia: Matopo Hills, April 17-30, type locality, 20 females (J. Ogilvie, L. Ogilvie, A. Mackie).

Transvaal: Louis Trichardt, April 4-10, five females (A. Mackie, J. Ogilvie). An occasional specimen from each locality has the front femora so dark as to be practically black, and hence suggests a reference to *A. transvaalensis* Strand. But, so far as I can gather from Strand's brief account, his species is distinctly larger and lacks the key-like depression on first tergite. Strand had three specimens, from Three Sisters in the Barberton District.

The species is noteworthy for having the clypeal mark like that usual in males of this group. A specimen from Shangani, De Beer's Ranch, May 8-12 (L. Ogilvie), has lost the abdomen, but it is confidently referred to the same species. It has the dull scutellum. Four males from the Matopo Hills (A. Mackie, J. Ogilvie, L. Ogilvie) are referred here; they resemble the female, but the scutellum is distinctly shining, the clypeal mark occupies the whole surface, except a slender oblique incision on each side, and the labrum and mandibles are light. Thus the male approaches *A. claripes* Friese, from French Guinea and the Gold Coast, but this species has the thorax hardly shining.

I found in the British Museum a specimen marked *A. rolini* Vachal, variety, compared with type by Meade-Waldo. It has the legs clear red, wings very clear, stigma very large, clypeal mark very broad, scape light in front. There is no locality label, but it is marked Sharp coll., 1905-313. The original *A. rolini* came from Boma Sundi, and had only the knees and tarsi reddish; instead of entirely red legs. Undoubtedly it is a different species.

#### *Allodapula maurula* (Cockerell)

Natal: Merebank, one female (J. Ogilvie); four females, The Bluff, Durban (W. P. Cockerell); one female, Durban (J. Ogilvie).

#### *Allodapula melanosoma*, new species

MALE.—Length about 5 mm.; black, shining, the mesothorax polished, the scutellum dull; clypeus white, with the usual median constriction, and with small lateral marks, contiguous with clypeus at lower end, but otherwise separated by a rather broad band of black; labrum white, mandibles black; antennae black; tubercles black; tegulae brown; wings clear hyaline; stigma brown, the margin darker; nervures light brown; second cubital cell receiving recurrent nervures some distance from base and apex; legs black, with white hair, the tarsi pale reddish only at tips; abdomen shining, first tergite with a pair of transverse depressions.



Southern Rhodesia: Matopo Hills, April 17-30, 1932 (J. Ogilvie). Distinguished from *A. albomaculata* (Cockerell) by the black mandibles and scape, and character of first tergite.

***Allodapula minuta* (Friese)**

This appears in Friese's 1924 table, p. 73, and we are told that it is very small, with dark legs, strongly grooved clypeus, clear wings and abdomen almost all black. It is referred on p. 70 to the group of *A. parvula*, but no locality is given. In The American Museum of Natural History I found a female from Durban, Natal, received from Friese. It ran in a couplet with *A. longula* (Friese), which is a distinct species, not a variety of *A. albipennis* Friese.

Wings milky white; stigma very pale; clypeus white, the light area broader (Windhoek).....*longula* (Friese), female.  
Wings grayish; stigma not so pale; clypeal mark light yellowish, and narrower.

*minuta* (Friese), female.

The clypeal mark of *A. minuta* is like that of *A. gracilis* (Bingham) which has a dark brown stigma. *A. gracilis* has the small joints of tarsi reddish yellow. I do not feel sure that *A. minuta* can be separated from *A. gracilis*.

***Allodapula monticola* (Cockerell)**

A second female from Calvinia, Cape Province (J. Ogilvie), differs from the type by having a very large transverse (fusiform) yellow mark on scutellum, and the upper border of prothorax with much yellow.

***Allodapula nativitatis*, new species**

**FEMALE.**—Length about 5.3 mm., anterior wing 4.2; black, rather robust, with scanty white hair; small joints of tarsi (as in the much smaller *A. gracilis* Bingham) red; labrum, mandibles, antennae and tubercles black; clypeus shining, not grooved or hollowed; clypeal mark dull yellow, occupying whole width of clypeus at top, but soon narrowing obliquely (not abruptly) to a moderately broad stem, which narrows apically, the whole outline like that of a flower with a tubular base; a strong swelling around front ocellus; mesothorax polished but scutellum dull; area of metathorax large, dull, with a somewhat shining margin; tegulae rather large, dark brown, pallid externally; wings ample, clear hyaline, beautifully iridescent; stigma large, dark brown, nervures brown; second cubital cell very broad above, receiving first recurrent nervure a short distance from base, and second a little nearer apex; hind legs with abundant white hair; abdomen broad, the apical part dull; first tergite shining, with a pair of swellings near apical border. The flagellum is very faintly brownish beneath. The upper edge of clypeal mark is straight.

Southern Rhodesia: Christmas Pass, Umtali, May 20-21, 1932 (J. Ogilvie). Very like *A. taia* Strand, as I have identified it, but that

has the broad part of clypeal mark quadrate, the tubercles yellow and the dorsal part of first tergite larger. Although they are very similar, I feel confident that they are distinct. It is larger than *A. innata*, the clypeal mark is a deeper yellow and the tubercles and tibiae are black. It is much larger than *A. maurula* with darker stigma.

#### *Allodapula nigriceps* (Friese)

FEMALE.—Length about 6 mm.; black, the face without light markings; clypeus shining, flattened, finely but very distinctly punctured all over; antennae black; tubercles black; mesothorax polished, but scutellum dull; tegulae hyaline; wings clear hyaline, with very pale nervures; stigma pale, with a heavy dark margin; second cubital cell receiving first recurrent nervure a short distance from base, the second very near apex; legs black, with white hair, tarsi rufescent at end; abdomen broad, the first three tergites shining; first tergite with a widely separated pair of bosses next to hind margin.

Southern Rhodesia: Matopo Hills, three females, one Oct. 1931 (J. Ogilvie) and two April 17–30, 1932 (L. Ogilvie, Alice Mackie). This species is very briefly cited, without locality, in Friese's 1924 table, but such information as is given agrees with the specimens before me.

#### *Allodapula nigrifula*, new species

FEMALE.—Length about 4.5 mm.; black, without light markings; head transverse, with wide face; clypeus little produced, flattened, very minutely punctured, with a slender median smooth line; flagellum faintly brownish beneath; mesothorax and scutellum highly polished; area of metathorax shining; tegulae brown; wings clear hyaline, with very pale nervures, and pallid stigma with light brown margin; second cubital cell receiving recurrent nervures a moderate distance from base and apex; legs black, the tarsi reddish at tips; abdomen broad, first tergite with a broad deep excavation, but no apical bosses.

Cape Province: Calvinia, Nov. 1931, three (T. D. A. Cockerell). This may be distinguished from several other black-faced females thus:

- 1.—Scutellum with a yellow mark; front and middle tibiae bright red in front.  
*monticola* Cockerell.
- 2.—Larger; scutellum dull. . . . . *nigriceps* Friese.
- 3.—Smaller; scutellum polished. . . . . 3.
- 3.—Larger; first tergite with two swellings near apical margin.  
*lacteipennis* Brauns, variety.
- Smaller; first tergite with no such swellings, but deeply excavated. .  
*nigrifula* Cockerell.

A characteristic feature of *A. nigrifula* is the short broad head. A female of this species comes from Van Rhyn's Pass, November (A. Mackie).

#### *Allodapula niunzua*, new species

FEMALE (type).—Length about 4.3 mm.; black, with the tarsi, and tibiae at

base, clear red; clypeus mainly yellow (reddened by cyanide in types), the yellow area only a little narrowed on apical half, the upper edge of the yellow straight; labrum black or a little brownish, mandibles black; scape black, with a minute light spot near base; flagellum brown to black, but always light reddish apically beneath; tubercles yellow; tegulae hyaline; wings hyaline, stigma very pale reddish, with no dark margin; nervures very pale, second cubital cell very narrow above, receiving first recurrent nervure very near base, but bulging considerably beyond second recurrent; mesothorax polished, with a strong median groove; scutellum dullish, but somewhat shining; area of metathorax dull; first tergite with a pair of shining bosses near hind margin. Friese and Strand stress the concavity of the clypeus in certain species; in the present species it is sometimes distinctly concave, but this is not constant.

Belgian Congo (District du Tanganika Moero): Niunzu, four females, Sept. 2, 1931 (J. Ogilvie). There is also a single male, 3.3 mm. long, with the same data. It is like the female, but the labrum is yellow, and the clypeal mark is broad below, with a little constriction on each side below the middle. The scape has two light dots.

This minute species differs from *A. albitarsis* Friese by the red tarsi. *A. pembana* Strand is closely allied, but has dark basitarsi, and the first recurrent nervure meeting intercubitus. *A. perpusilla* Strand differs by the T-like mark on clypeus and the tarsi not red.

#### *Allodapula paupercula*, new species

MALE.—Length about 4 mm.; black, both mesothorax and scutellum shining, the mesothorax with a strong median groove; clypeus white, not sulcate, with strong lateral constrictions, but no adjacent lateral marks (in the cotype the clypeus is reddened by cyanide); labrum white; mandibles black; antennae black; tubercles black; tegulae dark with pale margin; wings clear hyaline; stigma pale with dark margin; nervures pale; second cubital cell receiving first recurrent nervure a short distance from base, second nearer apex; legs black, the tarsi only reddish at tips; abdomen short and broad, the first tergite with a transverse shining apical band.

Southern Rhodesia: Matopo Hills, April 17–30, 1932 (Alice Mackie). Differs from *A. rufitarsis* Cockerell by the dark tarsi, lack of lateral marks near clypeal incisions, and other characters.

#### *Allodapula peratra*, new species

FEMALE.—Length about 5.6 mm.; black, rather robust, the head broader than long; no light marks on head or thorax; sides of thorax with thin grayish hair; clypeus shining, finely punctured; flagellum brownish beneath; mesothorax, scutellum and postscutellum polished; area of metathorax dull, with a shining margin; mesopleura highly polished; tegulae brown; wings clear hyaline but hardly milky; stigma pale brown, the margin darker; nervures very pale; second cubital cell receiving first recurrent nervure far from base, the second near end; basal nervure almost meeting nervulus; legs black, the tarsi a little brownish at end; scopa of hind

tibiae white; abdomen broad, more or less shining throughout (the apical tergites shining), the first tergite highly polished; hair on venter extremely short.

Cape Province: Oudtshoorn, Oct. 1931 (J. Ogilvie). In my tables it runs next to *A. nigritula* Cockerell, but it is much larger, and evidently quite distinct. Compared with *A. lacteipennis* it is larger, with darker stigma and other characters. The dark tubercles and other characters separate it from *A. vitrea* Vachal, which occurs at Delagoa Bay. In *A. paradoxa* Brauns the first recurrent nervure meets the intercubitus, and the abdomen is different.

#### *Allodapula poculifera*, new species

FEMALE.—Length, 7.6–8.5 mm.; black, with lemon-yellow markings as follows: clypeal mark occupying the whole width above, and below a broad band, the outline that of a goblet with a very broad stem, the sides of the broad part below sloping, not presenting an angle; upper border of prothorax and the tubercles also yellow; coxae, trochanters and femora black; front tibiae light red, blackened posteriorly; middle tibiae rather broadly red at end; hind tibiae black; tarsi all red; labrum with a minute yellow dot; mandibles black; flagellum obscurely brown beneath; front with a strong raised Y, the middle ocellus between the arms; mesothorax and scutellum highly polished; area of metathorax very large, dull; hair of thorax dull white; tegulae black, a little reddish externally; wings hyaline, the basal half faintly brownish, stigma large, dusky reddish, nervures dark brown; second cubital cell long, receiving first recurrent nervure some distance from base, second nearly at apex; coarse hair on hind tibiae and tarsi pale, slightly reddish; abdomen ordinary, the basal half shining, the apex turned upward.

Cape Province: Huguenot, Feb. 5–10, 1932 (J. Ogilvie). At Ceres occurs a variety with the upper border of prothorax black, with very minute yellow marks, the tubercles dark and slightly reddish, the wings distinctly reddish. It was collected Nov. 1920, by R. E. Turner; but another, from Mitchell's Pass, Ceres, Feb. 9–17 (J. Ogilvie), has the tubercles broadly yellow, and the wings not distinctly reddish. I assume that these are individual variations.

On account of the largely red legs, this falls in the group of *A. bevisi* Cockerell, *A. rufipes* Friese, etc., but it is easily separated by the much greater size.

#### *Allodapula pogonias* (Strand)

Transvaal: Louis Trichardt, April 4–10, twenty-three females and one male (*A.* Mackie, J. Ogilvie, L. Ogilvie). The male is new. It differs from male *A. maurula* (Cockerell) by the lemon-yellow clypeal mark, which is strongly excavated or concave on upper margin, while the lower half, below the lateral incisions, is suboval, not broadened laterally; labrum yellow but mandibles black (in *maurula* the mandibles

have a large light spot); wings not at all dusky; tarsi dull but pale reddish. *A. pogonias* was based on two females from "Kapland," collected by Krebs. It is rather large for a member of the *A. parvula* group, and the special character, stressed by Strand, is the concave upper margin of the clypeal mark. This is usually very distinct, but a few specimens have the margin practically straight. There are also two, which I believe should not be separated, in which the clypeal mark is T-like, with a slender stem. These might be referable to *A. nigrinervis* (Cameron), which is certainly very closely allied.

A series of twenty-seven females from the Matopo Hills, Southern Rhodesia, April 17-30, 1932 (J. Ogilvie, L. Ogilvie, A. Mackie, C. P. Harvey) is referred here, although many of them have the upper margin of the clypeal mark practically straight, and could be placed with *A. maurula* on this character. Further difficulty arises from the fact that these females are accompanied by five different males, none of them identical with the *A. pogonias* male from Louis Trichardt, nor with the male of *A. maurula*. There is, however, a single male which is near enough to *A. pogonias* to be regarded as a variation. The whole series of males separates out thus:

- 1.—Light face-marks with oblique incisions laterally, the appearance due to the development of small lateral marks, not on the clypeus.....2.  
No such small lateral marks on face.....4.
- 2.—Mandibles with a large white spot; scape yellowish white in front (Matopo Hills, one, A. Mackie).....*albomaculata*, n. sp.  
Mandibles black.....3.
- 3.—Larger; tubercles entirely black; scape black; tarsi dark (Matopo Hills, one, J. Ogilvie).....*melanosoma*, n. sp.  
Smaller; tubercles margined with white; tarsi pale red (Matopo Hills, one, A. Mackie).....*rufitarsis*, n. sp.
- 4.—Mandibles with a white spot; scape white in front (Natal)...*maurula* Cockerell.  
Mandibles with no white spot.....5.
- 5.—Scape all black; face-marks white; tubercles black (Matopo Hills, two, A. Mackie).....*paupercula*, n. sp.  
Scape with a light stripe; tubercles yellow.....6.
- 6.—Lower part of face-mark expanded, approaching orbits, but separated by a ridge which occupies the whole narrow space between face marks and orbits (Matopo Hills, one, A. Mackie).....*pogonias* Strand, variety.  
Lower part of face-mark not approaching orbits, the strong ridge well separated from it (Louis Trichardt).....*pogonias* Strand.

*A. facialis* (Gerst.), as determined by Friese, from Kigonsera (near north end of Lake Nyasa), runs to *A. pogonias*, variety, differing by the white instead of light red basitarsi. *A. facialis* was based on the female,

from Mozambique, and judging from the description, I do not believe this male belongs with it. The mesothorax is highly polished.

*A. albipes* (Cockerell) has the lateral marks, but they are very small; the mandibles have a large white spot; scape all black, flagellum red beneath, tubercles light-margined. It is from Graaff Reinet.

*A. elizabethana* (Brauns) runs out at 5, having the face-mark orange.

There are seventeen female *A. pogonias* from Umtali (Vumba and Christmas Pass), Southern Rhodesia, May (J. Ogilvie, L. Ogilvie, A. Mackie). Three females from Zimbabwe, Sept. 30 (Cockerell, A. Mackie), and ten from Shangani (De Beer's Ranch), May (J. Ogilvie, L. Ogilvie, A. Mackie), form a group averaging distinctly smaller but otherwise not to be separated. Regarding all these females from different localities, I find it impossible to separate *A. pogonias* in this sex from *A. maurula*, but the males (the holotype of *A. maurula* is a male) are readily separable. *A. maurula* was published in December 1917; Strand's species is dated 1914, but owing to circumstances then prevailing, did not reach me until long after (see Ann. Mag. Nat. Hist., Aug. 1934, p. 251). It is impossible to be quite sure, without breeding records, that I have correctly identified the male of *A. pogonias*. Two males from De Beer's Ranch have the clypeal mark white, expanded below, the scape white in front and the basitarsi white. In general, they are like *A. maurula*, but they differ by the black mandibles, and the little lateral marks next to sides of clypeus. For the present, I place them as a variety of *A. pogonias*, but with misgivings.

#### *Allodapula pulchripes*, new species

FEMALE.—Length about 5 mm.; black, with the legs, except the coxae, bright chestnut red; scape broadly red in front; clypeal mark white, occupying the whole of upper half, but the lower half of the mark, though broad, cuneiform, narrowing to a blunt apex; tubercles white; tegulae hyaline; wings clear hyaline, with large nearly black stigma; nervures light brown. In some specimens the clypeal mark is yellowish. Labrum reddish; mandibles black; flagellum black; front shining; mesothorax highly polished; scutellum dull, but anteriorly shining seen from in front; recurrent nervures received equally distant from base and apex of second cubital cell; hair of hind legs slightly golden; hind margins of tergites narrowly reddish; first tergite with a pair of depressions near apical margin.

Southern Rhodesia: Matopo Hills, April 17–30 (L. Ogilvie, A. Mackie). Allied to *A. rufipes* Friese, but that has the scape white in front, and red mandibles, and comes from Kigonsera, near the north end of Lake Nyasa. Four specimens were taken.

A specimen from Lubumbashi, Katanga, July 22, 1920 (Michael

Bequaert), is provisionally referred here as a variety. The stigma is red, the scape shows less red, the scutellum is less shining, and the clypeal mark is light yellow, with the angle at the constriction almost a right angle. A second specimen, with the same data, agrees, except that the scape has even less red, only a basal spot. This insect is intermediate between *A. pulchripes* and *A. littoralis*, but probably constitutes a distinct race.

***Allodapula pusilla*, new species**

FEMALE.—Length about 4 mm.; black, including labrum, mandibles and scape, flagellum brownish beneath; clypeal mark yellow, T-like, but with a very stout parallel-sided stem, and extremely short arms, the downwardly directed projections defined only by a brown line on each side; the upper margin is straight; mesothorax highly polished; scutellum shining but not polished; area of metathorax dull seen from above, a little shining seen from behind; tegulae brown, rather pale; wings strongly reddened; stigma dusky red with a dark margin; nervures brown; second cubital cell short, first recurrent nervure joining extreme basal corner, second a moderate distance from apex; abdomen shining throughout, hind margins of tergites reddened, tubercles of first tergite poorly developed.

Southern Rhodesia: type from Vumba, Umtali, May 23–26 (A. Mackie). Another from Christmas Pass, Umtali, May 20–21 (J. Ogilvie). For comparisons see *A. krugeri*.

***Allodapula rhodesi*, new species**

FEMALE.—Length, 4 to 4.5 mm.; black, including labrum, mandibles and antennae, the flagellum obscurely brownish beneath; clypeal mark creamy white, T-like, but the stem is long, and the transverse arms are very short, squarely truncate, with no projecting points (a second specimen shows small points at lower corners); tubercles with a slender light margin; mesothorax polished, posteriorly dull; scutellum and area of metathorax dull; tegulae dark brown; wings dusky (not reddened), with a brilliant pink and green iridescence; stigma dark reddish, nervures brown; second cubital cell very long, receiving second recurrent nervure far from end, first recurrent meeting intercubitus; legs black, hind tibiae with much white hair; abdomen broad, shining throughout.

Southern Rhodesia: Matopo Hills, April, two (J. Ogilvie). For comparisons, see *A. krugeri*.

***Allodapula rufipennis*, new species**

FEMALE.—Length about 7 mm.; black, including labrum, mandibles, antennae and tubercles; tegulae very dark brown, almost black; wings very strongly reddened; stigma reddish, with a heavy black margin; second cubital cell long, receiving first recurrent nervure near base, second more remote from apex; marginal cell on second cubital longer than on first; clypeus produced, with a yellow mark like that of *A. hamatifera* with a very long parallel-sided moderately thick stem, the transverse bar at upper end short, and produced to a hook-like form downward at each end; meso-

thorax highly polished; scutellum rather short, somewhat shining but not polished; area of metathorax dull; legs black, the tarsi slightly brownish apically; hair of sides of thorax and of legs dull white; first tergite deeply excavated, the sharply defined marginal region forming a shining band, which has in the middle a slight elevation, but there are no paired tubercles; sternites fringed with short white hair.

Belgian Congo (District du Kivu): Tshibinda, Aug. 24, 1931 (J. Ogilvie). It runs out at 26 in Friese's table, and it finds no place in that of Strand. It is actually very close to *A. hamatifera* Cockerell, but apparently a distinct species, on account of the red wings, the distinctly narrower head and thorax and the smaller, shining scutellum. A male which I can only refer to *A. rufipennis* was taken at Tshibinda by J. Ogilvie. It has a bright orange clypeal mark, deeply constricted in middle (with no little lateral marks), the upper part broadly goblet-shaped, straight above, convex at sides, the lower part large and extending right across clypeus; labrum with a large yellow spot; mandibles, antennae and tubercles entirely black; hind trochanters with two dentiform projections. The wings are strongly reddish, and the second cubital cell is extremely broad on marginal.

#### *Allodapula rufitarsis*, new species

MALE.—Length about 3.5 mm.; black, broad, shining, mesothorax highly polished, scutellum shining seen from in front; clypeus shining yellow, the light color with small lateral constrictions, next to which are small and short lateral marks; labrum yellow; mandibles black; scape black; frontal keel very strong; tubercles with a pale crescent; tegulae hyaline; wings clear hyaline; stigma light brown with dark margin; nervures brown; second cubital cell receiving first recurrent nervure rather far from base, second near apex; tarsi very pale reddish; abdomen very short and broad, subglobose.

Southern Rhodesia: Matopo Hills, April 17-30, 1932 (Alice Mackie). Distinguished from *A. melanosoma* Cockerell by the smaller size, white-margined tubercles and pale tarsi. The clypeus is not grooved, as it is said to be in *A. minuta* Friese. Two males from Blaukrans, near Calvinia (Cockerell), are referred here. One has the little lateral marks next to clypeus as in the type, but the other lacks them. In the former the basitarsi are creamy white, in the later very pale red. The flagellum has a hardly noticeable reddish or brownish tinge beneath. Another male from Blaukrans (J. Ogilvie) has the face-mark broader, and the little lateral marks are longer than in the type, going about halfway up the upper part of clypeal mark, from which they are separated by a very slender line.

The following key separates this species from several similar ones (males):



- 1.—Scutellum polished; wings perfectly clear; mandibles not spotted.  
*rufitarsis*, n. sp.  
 Scutellum not polished. . . . . 2.  
 2.—Legs red; mandibles not spotted. . . . . *matopina* Cockerell.  
 Legs not red. . . . . 3.  
 3.—Mandibles not spotted; face-mark white; tubercles black. *melanosoma* Cockerell.  
 Mandibles conspicuously spotted. . . . . 4.  
 4.—Wings reddish; stigma large and dark; hind basitarsi clear light yellow; small lateral marks rather remote from upper part of clypeal mark.  
*umtalica ornata* Cockerell.  
 Wings not at all reddish. . . . . 5.  
 5.—Clypeal mark broader, cream-color, with conspicuous small lateral marks opposite constriction; wings perfectly clear. . . . . *albomaculata* Cockerell.  
 Clypeal mark narrower, broad below, with no little marks opposite constriction; wings grayish. . . . . *maurula* Cockerell.

A male from National Park, Natal, March (L. Ogilvie) is provisionally referred to *A. rufitarsis* as a variety. The wings are not so clear, and there are no little marks by the lateral incisions of clypeal mark. Also, the mandibles are without spots. The scutellum is polished as seen from in front.

A female which I ascribe to *A. rufitarsis* is from Shangani, De Beer's Ranch, May (A. Mackie). It is about 4.5 mm. long (much smaller and less robust than *A. vernayi*) and is separated from various allied forms by the clypeal mark truncate (not rounded) above, the wings clear hyaline and the stigma pale, with a dark margin. The clypeal mark is white, T-like, with a long stem; tubercles with a pale spot; scutellum not polished. One from Bianco, Katanga, August (J. Ogilvie) is provisionally referred here as a variety, but the clypeal mark is yellow and the transverse bar is thicker. It is probably a distinct species. These females have the tarsi black, rufescent only at tip.

#### *Allodapula rufosticta*, new species

**FEMALE.**—Length about 6.8 mm; black, including labrum, mandibles and scape; flagellum faintly brownish beneath, but fourth antennal joint with a large red spot on under side; clypeal mark T-like, pale yellow, the upper (transverse) part thick, but hardly half length of stem, its upper margin slightly concave; stem thick, nearly parallel-sided, at upper end broader than the combined lateral extensions; mesothorax highly polished, the median sulcus distinct; scutellum highly polished all over; area of metathorax large, dull, with a shining margin; tubercles yellow; tegulae very dark brown; wings brownish hyaline; stigma large, dusky reddish, with a dark margin; nervures pale; second cubital cell receiving first recurrent nervure a short distance from base, the second more remote from apex; legs black, the tarsi rufescent apically; hair of hind legs pale reddish; abdomen broad, the first three tergites shining, hind margins of fourth and fifth narrowly brown; first tergite with a swelling on each side near hind margin.

Cape Province: Montagu Pass, Oct. 4, 1931 (L. Ogilvie). Nearest to *A. acutigera* Cockerell, which it resembles in the polished scutellum, though the clypeal mark is quite different. In *A. acutigera* the fourth antennal joint shows an excessively minute red spot beneath. By the various tables, it runs to a series of species, from which (females) it is separated thus:

- 1.—Scutellum dull or hardly shining. . . . . 2.  
Scutellum evidently shining; tubercles marked with yellow. . . . . 3.
- 2.—Broad upper (transverse) part of clypeal mark a rather narrow band; tubercles black. . . . . *nigricollis* Vachal.  
Broad upper part of clypeal mark subquadrate, not greatly shorter than the stem; tubercles with a light mark. . . . . *taita* Strand.
- 3.—Smaller; broad part of clypeal mark about as long as stem; flagellum with no red spot near base. . . . . *maurula* Cockerell.  
Larger; broad part of clypeal mark much shorter than stem; flagellum with a red spot near base. . . . . *rufosticta* Cockerell.

#### *Allodapula rugosella*, new species

FEMALE.—Length about 4 mm.; shining black (the abdomen shining to apex); labrum rufous, but mandibles black; antennae black, flagellum thick; clypeus with a delicate median groove; clypeal mark a broad yellow band (reddened by cyanide in type), in middle about as broad as the black area on each side of it, its upper end for a short distance evidently but not greatly expanded, its upper margin straight; mesothorax finely roughened and with scattered minute punctures, not polished; scutellum finely punctured and dullish; tubercles with a yellow border; tegulae pale testaceous; wings dusky hyaline; stigma pale with a dark brown border; nervures pale; second cubital cell receiving recurrent nervures some distance (about equally distant) from base and apex; legs black, the tarsi obscurely rufescent apically; first tergite without distinct tubercles.

Belgian Congo: Kabalo, Aug. 15, 1931 (J. Ogilvie). By the clypeal band it resembles *A. gorillarum*, which is larger, with darkened stigma, and the form of the clypeal mark is really quite different. It is in many respects similar to *A. minuta* Friese, and it nearly agrees with *A. minutula* Friese from Kigonsera, though the broad abdomen (parallel-sided except at base and apex) is not cylindrical, and the segments do not have whitish bands. It evidently falls in the same group, of minute species with roughened (not polished) mesothorax.

A male from Tenke, July–Aug. (T. D. A. Cockerell) is referred to *A. rugosella* with confidence. It is about 4 mm. long and has the minutely sculptured mesothorax. The clypeus is yellow (reddened by cyanide), not very deeply constricted in middle, the upper margin slightly concave, the sides of upper part gently convex, the lower part as wide as upper, with a prominent shoulder on each side above, but there are no little

lateral marks. Labrum yellow; mandibles black; scape with a slender yellow stripe, tubercles with a bright yellow crescent. The tarsi are yellowish white. This comes near *A. albitarsis* Friese, from Eritrea.

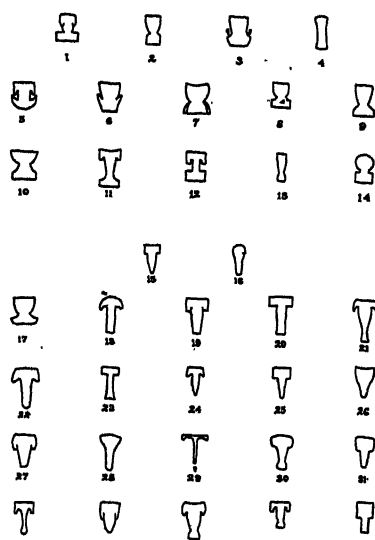
*Allodapula umtalica*, new species

MALE—Length about 5 mm.; black, with shining claviform abdomen, narrowed basally; mandibles, flagellum and tubercles black; labrum with a minute yellow spot at upper end; clypeal mark a very broad yellow band, broadly and shallowly constricted at sides, the upper edge straight, the sides of the upper part straight but gently sloping inward, the sides of the shorter lower part strongly rounded; no little lateral marks; scape with a pale stripe; thorax with quite abundant grayish-white hair; mesothorax polished, scutellum shining but not polished; area of metathorax large, dull with shining margin; mesopleura shining; tegulae small, dark brown; wings strongly brownish; stigma dark brown, nervures brown; second cubital cell very broad above, receiving first recurrent nervure at extreme basal corner, second some distance from apex; marginal tubercles on first tergite nearly obsolete; hind margins of tergites not pallid; legs black, with pale reddish tarsi, the hind basitarsi blackened at base.

Southern Rhodesia: Vumba, Umtali, May 23–26, 1932 (J. Ogilvie). The clypeal mark suggests *A. gorillarum*, from near Lake Kivu, but it is much broader than the black areas on each side of it, whereas in *A. gorillarum* it is at middle not broader than the black areas. *A. gorillarum* also has dark basitarsi.

There is a series of males from Umtali, most of which will run to *A. facialis* Gerstaecker in Friese's table, but they all differ from that in the dark brown tegulae and other characters. They may be separated thus:

- 1.—Mandibles with a large yellow spot; conspicuous short stripes laterad of the constrictions of facial mark; tubercles yellow; wings very brown; abdomen broad at base..... *umtalica ornata*, new variety.  
Mandibles all black, or with small spot; lateral stripes of face absent or rudimentary..... 2.
- 2.—Clypeal mark with the upper part heart-shaped, emarginate above; wings pale, slightly brownish; second recurrent nervure much more distant from end of second cubital cell than first from base; scape with a yellow stripe; tubercles with a yellow crescent..... *pogonias* Strand, variety.  
Clypeal mark with the upper part narrower, not heart-shaped; wings browner. . 3.
- 3.—Tubercles all black; clypeal mark a broad band..... *umtalica* (typical form).  
Tubercles marked with yellow..... 4.
- 4.—Scape all black; mandibles with light spots..... 5.  
Scape with light markings..... 6.
- 5.—Lower part of clypeal mark distinctly broader than upper. . . . *umtalica*, variety b.  
Lower part of clypeal mark not broader than upper..... *umtalica*, variety c.
- 6.—Mandibles with a minute light spot..... *umtalica*, variety d.  
Mandibles not spotted..... *umtalica*, variety e.



## Face-marks of males:

- |                                |                                   |
|--------------------------------|-----------------------------------|
| 1. <i>Allodapula luapulina</i> | 8. <i>Allodapula elizabethana</i> |
| 2. " <i>rugosella</i>          | 9. " <i>maurula</i>               |
| 3. " <i>ornata</i>             | 10. " <i>rufipennis</i>           |
| 4. " <i>umtalica</i>           | 11. " <i>angolensis</i>           |
| 5. " <i>melanosoma</i>         | 12. " <i>wilmattae</i>            |
| 6. " <i>albomaculata</i>       | 13. " <i>gorillarum</i>           |
| 7. " <i>flavolateralis</i>     | 14. " <i>lucidula</i>             |

## Face-marks of females:

- |                                  |                              |
|----------------------------------|------------------------------|
| 15. <i>Allodapula antiquorum</i> | 26. <i>Allodapula innata</i> |
| 16. " <i>rugosella</i>           | 27. " <i>bukaviella</i>      |
| 17. " <i>matopina</i>            | 28. " <i>kivuensis</i>       |
| 18. " <i>conveza</i>             | 29. " <i>debilitata</i>      |
| 19. " <i>pustilla</i>            | 30. " <i>malleifera</i>      |
| 20. " <i>rhodesi</i>             | 31. " <i>maurula</i>         |
| 21. " <i>bulbifera</i>           | 32. " <i>rufipennis</i>      |
| 22. " <i>krugeri</i>             | 33. " <i>pulchripes</i>      |
| 23. " <i>fuscinervis</i>         | 34. " <i>diloloensis</i>     |
| 24. " <i>nigrinervis</i>         | 35. " <i>luckhoffi</i>       |
| 25. " <i>gracilis</i>            | 36. " <i>longula</i>         |

It is quite possible that *A. umtalica* is represented only by the type, all the varieties being referable to a distinct species, *A. ornata*. All have

dark brown tegulae; clypeus convex, shining, not at all grooved or hollowed; mesothorax polished, scutellum somewhat shining but not at all polished. The size is the same in all. In the types of *A. umtalica* and *ornata*, the first recurrent nervure joins the extreme basal corner of second cubital cell; in the others it is as far from base as the second from apex. In no case does it actually meet the intercubitus. The tarsi have the basitarsi cream-color (clear or dusky) and the small joints rufescent, suggestive of *A. rufitarsis*, which is easily separated by the perfectly clear wings. As regards the spot on mandibles, variety *c* has quite a distinct spot, somewhat triangular; but *b* has very minute spots, and *d* the same, on one side only. The variety *c*, looked at from the front, appears to have the scape all black, but on one side there is an imperfect pale stripe, visible in lateral view. It is thus evident that the characters given to distinguish *b*, *c*, *d*, and *e* do not even separate recognizable races or varieties. The *ornata* form appears to belong to the same series, being the extreme most remote from *umtalica*.

All the varieties are from Vumba, Umtali (J. Ogilvie, L. Ogilvie). So also the *A. pogonias* variety. I have not found a female for *A. umtalica*, but suspect that it is represented among the numerous specimens which I have not felt able to separate from *A. pogonias*. A male from Uvira, Belgian Congo, Aug. 28-29 (J. Ogilvie) is referred to *A. umtalica ornata*, though the upper part of clypeal mark is wider and the first recurrent nervure is much more distant from base of second cubital cell. The wings are reddened and the scape has a yellow stripe in front. Another from Uvira (J. Ogilvie) was separated because the little lateral marks are punctiform, nearly obsolete. It is evidently the same species, but the Uvira insect may have to be separated from *A. umtalica ornata* when better known.

***Allodapula usambaricola* (Strand)**

Tanganyika Territory: Dar-es-Salaam, four females, June 9 (J. Ogilvie); Tanga, two females, June 10 (J. Ogilvie, L. Ogilvie).

Sudan: Port Sudan, one female, June 26 (J. Ogilvie).

The stigma is large and well developed.

***Allodapula wilmattae* (Cockerell)**

Belgian Congo: Tenke, one male (Alice Mackie).

Southern Rhodesia: Males from Battery Spruit, near Umtali (J. Ogilvie), and Christmas Pass, Umtali (J. Ogilvie). The tongue and labial palpi in this species are very long.

# AMERICAN MUSEUM NOVITATES

Number 841

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

April 11, 1931

## RECORDS OF NORTH AMERICAN GNAPHOSIDAE WITH DESCRIPTIONS OF NEW SPECIES

BY RALPH V. CHAMBERLIN

In this paper are given records of the species of Gnaphosidae represented in an interesting collection submitted for identification through the courtesy of Dr. Willis J. Gertsch and the officials of The American Museum of Natural History. The material, collected at various times chiefly by Henry W. Britcher and Drs. F. E. Lutz and W. J. Gertsch, came for the most part from Arizona, California, Colorado, Utah, and New York. Fifty-six species are represented. Unless otherwise indicated, the types and paratypes are in the collection of The American Museum of Natural History.

### HERPYLLUS HENTZ

#### *Herpyllus propinquus* (Keyserling)

*Prothesima propinqua* KEYSERLING, 1887, Verh. zool.-bot. Gesell. Wien, p. 430, Fig. 7.

*Herpyllus californicus* BANKS, 1904, Jour. N. Y. Ent. Soc., p. 110.

RECORDS.—California: one female, immature, Britcher coll.; Los Angeles, one female, coll. G. Grant, Nov.-Dec., 1922.

#### *Herpyllus vasifer* (Walckenaer)

*Drassus vasifer* WALCKENAER, 1805, 'Tabl. Aran.', p. 46.

*Herpyllus ecclesiasticus* HENTZ, 1832, Amer. Jour. Sci. and Arts, XXI, p. 102.

*Herpyllus vasifer* SIMON, 1893, 'Hist. Nat. Araign.', I, p. 373.

RECORDS.—Ontario: St. Thomas, one female, Lorne E. James coll.—Pennsylvania: Washington, one female, W. W. Long coll.

#### *Herpyllus hesperolus* Chamberlin

*Prothesima valida* BANKS, 1901, Proc. U. S. Nat. Mus., XXIII, p. 582. (nom. preocc.).

*Herpyllus hesperolus* CHAMBERLIN, 1928, Proc. Biol. Soc. Wash., XLI, p. 176.

RECORD.—Utah: Richfield, one female, W. Gertsch coll., July-Aug., 1930.

*Herpyllus convallis*, new species

Figures 1, 2, and 3

MALE.—Cephalothorax light orange-yellow, the legs a clearer yellow. Abdomen gray or yellowish with a sagittate basal mark, above more yellow. Body in general clothed about as usual with finer plumose whitish hairs and the sparser, larger suberect setae.

Tarsi of legs I and II scopulate, the corresponding metatarsi more sparsely scopulate nearly to the base. Tarsi III and IV also scopulate but not the corresponding metatarsi. Tibia I with ventral spines 1-1-1, unarmed laterally. Tibia II with ventral spines 1(0)-1-1, a single spine on anterior face toward distal end. Metatarsi I and II with a pair of ventral spines at base. Tibiae III and IV with a single median dorsal spine toward base.

Cephalothorax low throughout, the head region not at all elevated. Anterior median eyes larger than the laterals, their radius apart and much closer to the laterals. Posterior median eyes about their diameter apart and a very little farther from the laterals. Area of median eyes wider in front than behind (ad 6:5), the length nearly the same as the width anteriorly. Lateral eyes on each side separated by about four-fifths the diameter of a posterior one, which is smaller than the anterior one.

The tibial apophysis of the male palpus with chitinous apical portion slenderly acute, curved forward and a little ventrad; somewhat suggesting the apophysis in *H. hesperolus* Chamberlin but not distally furcate. For details of structure see the figures.

FEMALE.—Coloration and spining of legs as in the male, but lacking a distinct sagittate mark at the base of abdomen, and the spine on anterior face of tibia II. Eyes also similar but the anterior median eyes relatively somewhat smaller and a little farther apart. Epigynum distinctive, see figure.

Male.—Total length, 9.00 mm. Length of cephalothorax, 4.00 mm.; width, 300 mm.

Legs:	I	II	III	IV
Coxa-trochanter.....	2.10 mm.	2.00 mm.	2.00 mm.	2.10 mm.
Femur.....	4.30 "	4.00 "	3.20 "	4.00 "
Tibia-patella.....	5.20 "	5.10 "	4.25 "	5.00 "
Metatarsus.....	3.00 "	3.00 "	2.80 "	4.00 "
Tarsus.....	1.75 "	1.75 "	1.70 "	1.75 "
TOTAL	16.35 mm.	15.85 mm.	13.95 mm.	16.85 mm.

Female.—Total length, 11 mm. Length of cephalothorax, 5.80 mm.; width, 4.20 mm.

Legs:	I	II	III	IV
Coxa-trochanter.....	2.80 mm.	2.20 mm.	2.20 mm.	2.80 mm.
Femur.....	4.00 "	3.90 "	3.80 "	4.50 "
Tibia-patella.....	5.50 "	5.10 "	4.30 "	5.80 "
Metatarsus.....	3.00 "	3.00 "	3.00 "	4.80 "
Tarsus.....	2.00 "	2.00 "	2.00 "	2.00 "
TOTAL	17.3 mm.	16.2 mm.	15.3 mm.	19.9 mm.

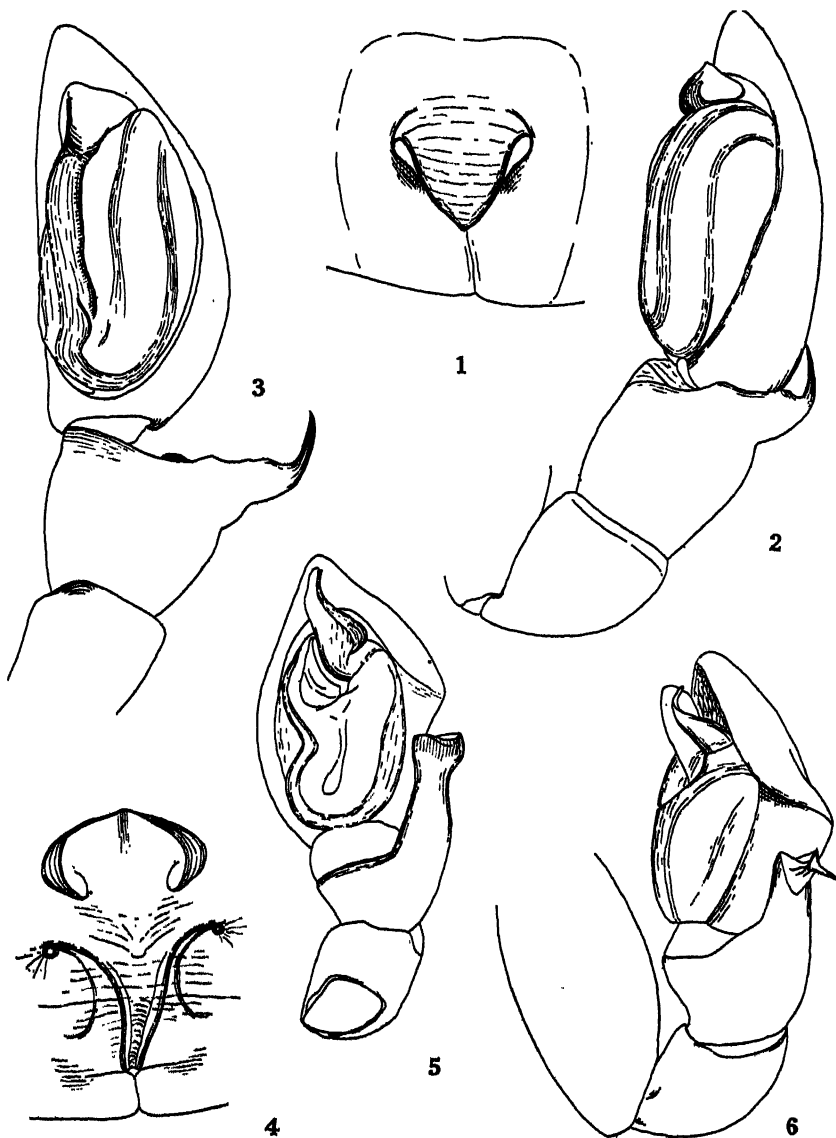


Fig. 1. *Herpyllus conwallis*, new species, epigynum.  
 Fig. 2. Idem, left palpus of male, ectal view.  
 Fig. 3. Idem, left palpus of male, ventral view.  
 Fig. 4. *Liodrassus arizonicus*, new species, epigynum.  
 Fig. 5. Idem, left palpus of male, ventral view.  
 Fig. 6. Idem, left palpus of male, ectal view.



LOCALITY.—Arizona: Scottsdale, Britcher coll., Dec. 30, 1902, two adult males (one of which is designated the holotype), one adult female (allotype), and four immature females.

**LIODRASSUS, NEW GENUS**

In general structure close to *Herpyllus* from which most readily distinguished in lacking teeth on the margins of the furrow of the chelicerae, the lower margin being wholly smooth and the upper margin, at most, bearing a low chitinous keel not broken into distinct teeth. Posterior median eyes less than their diameter apart. Anterior median eyes decidedly larger than the laterals. Tibiae III and IV with no median dorsal spines. In male palpus the femur with a conspicuous angular prominence on the ectoventral side; cymbium excavated on exterior side for reception of tibial apophysis.

GENOTYPE.—*L. arizonicus*, new species.

***Liodrassus arizonicus*, new species**

Figures 4, 5, and 6

MALE.—Carapace and sternum pale chestnut. Carapace clothed as usual with rather sparse, dark long setae which are longer in the eye region, and finer appressed, plumose white hair. Sternum clothed with dark setae which are longer about the borders. Legs more yellowish. Abdomen gray with a light chestnut scutellum at base above; clothed with coarser erect or suberect setae and fine, plumose, appressed white hair.

Tarsi and metatarsi of legs I and II scopulate beneath, the scopulae of metatarsi the more sparse. Tarsi and metatarsi III and IV not scopulate. Tibia I with a single ventral spine at distal end; metatarsus I with a pair of stout ventral spines at proximal end. Tibia II with ventral spines 0-1-1 to 0-2-2; metatarsus II with a pair of spines at proximal end. Tibiae III and IV with no median dorsal spines.

Anterior row of eyes procurved, with the laterals their diameter or a little more from the margin of the clypeus; medians decidedly larger than the laterals (diameters approximately as 4:3), two-thirds their radius apart, and almost contiguous with the laterals. Posterior row of eyes nearly straight. Median eyes smaller than the laterals (ad 9:10), somewhat oblique, two-thirds their diameter apart, rather less than their radius from the laterals; lateral eyes about their radius from the anterior laterals. Area of median eyes as wide anteriorly as long, wider anteriorly than behind (ad 26:23). Palpus as shown in the figures.

FEMALE.—Coloration and spining of legs as in the male. Posterior row of eyes gently procurved. Disproportion in eyes of anterior row rather less than in the male. Epigynum as shown in the figure.

Male.—Total length, 7.00 mm. Length of cephalothorax, 3.20 mm.; width, 2.00 mm.

Legs:	I	II	III	IV
Coxa-trochanter.....	1.30 mm.	1.17 mm.	1.08 mm.	1.30 mm.
Femur.....	1.90 "	1.80 "	1.73 "	2.17 "
Tibia-patella.....	2.43 "	2.39 "	2.17 "	2.60 "
Metatarsus.....	1.17 "	1.17 "	1.30 "	1.90 "
Tarsus.....	0.86 "	0.70 "	0.78 "	0.86 "
TOTAL	7.66 mm.	7.23 mm.	7.06 mm.	8.83 mm.

Female.—Total length, 10.00 mm. Length of cephalothorax, 4.20 mm.; width, 2.80 mm.

Legs:	I	II	III	IV
Coxa-trochanter.....				
Femur.....	2.80 mm.	2.50 mm.	2.10 mm.	3.00 mm.
Tibia-patella.....	3.50 "	3.10 "	2.90 "	3.50 "
Metatarsus.....	1.50 "	1.40 "	1.80 "	2.25 "
Tarsus.....	1.00 "	1.00 "	1.00 "	1.20 "
TOTAL	8.80 mm.	8.00 mm.	7.80 mm.	9.95 mm.

LOCALITY.—Arizona: Scottsdale, Britcher coll., Dec. 30, 1902, one adult male (holotype), one adult female (allotype), and three immature females.

*Liodrassus florissantus*, new species

Figures 7, 8, and 9

MALE.—Carapace and sternum orange-colored, the legs more yellowish. Abdomen dark gray above excepting the brownish scutellum at base; ventral surface lighter in color. Hair of body mostly rubbed off of type but apparently in general as in the preceding species.

Leg I with tarsus and metatarsus scopulate, the scopula of metatarsus more sparse and not reaching proximad of middle. Tarsi of legs III and IV very sparsely scopulate except at apex, the corresponding metatarsi not at all scopulate. Tibia I with ventral spines 0-0-2. Metatarsus I with a single ventral spine at base. Tibiae III and IV with no median dorsal spines.

Chelicerae long, nearly straight, and narrowing distad much as in the genotype. A rounded setiferous elevation or keel above near base of keel, but with no chitinous keel or teeth at angle where a keel is present in *arizonicus*. Lower margin wholly smooth.

Eyes nearly as in *arizonicus*, but the anterior medians relatively somewhat smaller. Clypeus slanting forward more than in the other species.

The male palpus of the same general type as in *arizonicus* though differing throughout in details. From the latter form readily distinguishable in having the femur more curved and with a conspicuous angular prominence on the ectal side immediately proximad of the middle as shown in the figure.

Male.—Total length, 5.80 mm. Length of cephalothorax, 2.70 mm.; width, 1.90 mm.

Legs:	I	II <sup>1</sup>	III <sup>1</sup>	IV
Coxa-trochanter.....	1.20 mm.			1.20 mm.
Femur.....	1.90 "			2.00 "
Tibia-patella.....	2.10 "			2.60 "
Metatarsus.....	1.20 "			1.70 "
Tarsus.....	0.90 "			0.90 "
TOTAL	7.30 mm.			8.40 mm.

<sup>1</sup> Legs II and III missing.

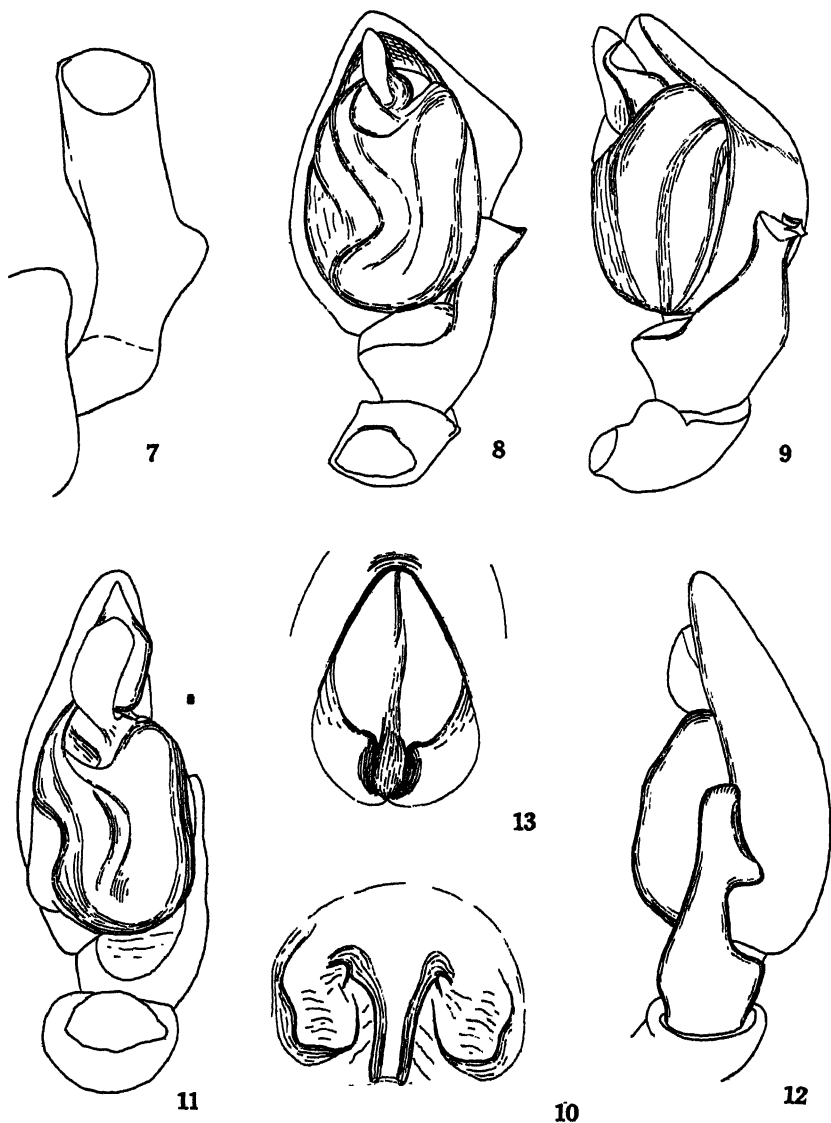


Fig. 7. *Liodrassus florissantus*, new species, femur of left palp of male, sub-ventral view.

Fig. 8. Idem, left palp of male, ventral view.

Fig. 9. Idem, left palp of male, ectal view.

Fig. 10. *Liodrassus utus*, new species, epigynum.

Fig. 11. *Poecilochroa abjecta*, new species, left palp of male, ventral view.

Fig. 12. Idem, left palp of male, ectal view.

Fig. 13. *Sergiolus bebius*, new species, epigynum.

LOCALITY.—Colorado: Florissant, July 2, 1908, male holotype, F. E. Lutz coll.

***Liodrassus utus*, new species**

Figure 10

FEMALE.—Carapace, sternum, and chelicerae pale chestnut, the legs more yellowish except the last two joints of the first pair which are darker. Carapace sparsely clothed with appressed hairs which are white intermingled with darker ones; longer dark setae as usual, these more conspicuous in ocular and clypeal region. Sternum with some fine plumose white hairs and numerous coarser dark setae which are more conspicuous about the borders as usual. Abdomen light gray or whitish throughout, with a median mark above obviously indicated. Hair as in preceding species.

Tarsi and metatarsi of legs I and II scopulate as usual, the scopulae on metatarsi not extending entirely to proximal end; scopular hairs also more sparsely present on tarsi III and IV over distal portion, but mostly replaced with short aculeate setae. Tibiae I and II with two short spines on anterior side of ventral surface, one being near middle and one at distal end. Metatarsi I and II with a single ventral spine at proximal end. Tibiae II and III with no median dorsal spines.

Anterior row of eyes procurved; the medians more than their radius apart very close to the laterals; median eyes scarcely larger than the laterals, the latter about their diameter from lower margin of the clypeus. Posterior row of eyes slightly procurved; median eyes oblique, larger than the laterals (long diameter as 9:8), nearly their long radius apart as far or farther from laterals; lateral eyes about their radius from the anterior laterals. Area of median eyes as wide in front as behind, longer than wide (cir. 6:5). Epigynum as figured.

Length, 7 mm. Length of cephalothorax, 2.25 mm.; width, 2 mm. Tibia and patella I, 2.20 mm.; tibia and patella IV, 2.25 mm.

LOCALITY.—Utah: Richfield, July–Aug., 1930, coll. by W. Gertsch, female holotype.

**POECILOCHROA WESTRING**

***Poecilochroa montana* Emerton**

*Poecilochroa montana* EMERTON, 1890, Trans. Conn. Acad., VIII, p. 175, Pl. iv, figs. 2, 2a.

*Poecilochroa pacifica* BANKS, 1896, Jour. N. Y. Ent. Soc., IV, p. 89.

RECORDS.—California: Los Angeles, one immature female, G. Grant coll.—Utah: Richfield, one male, W. Gertsch coll., July 4, 1930; Salt Lake City, three males and three females, W. Gertsch coll., June–Sept., 1930.

***Poecilochroa abjecta*, new species**

Figures 11 and 12

MALE.—Carapace dusky chestnut, the sternum similar, nearly black. Cheli-

cerae with network of black lines on anterior face. Legs with femora black or nearly so, the posterior ones with lighter longitudinal bands above; articles distad of the femora yellowish or yellowish brown, the patellae dark across distal end, especially so in the case of the posterior legs, and the tibiae darkened at proximal end, more so on posterior pairs and especially the fourth. Abdomen dusky gray above with a pair of transverse light spots at middle; paler ventrally; a large and distinct scutellum over basal portion above.

Tarsi and metatarsi I and II scopulate, the scopulae of metatarsi more sparse toward proximal end. Metatarsi III and IV not scopulate, the tarsi scopulate as usual. Tibia I with ventral spines 0-0-2. Tibia II with ventral spines 0-2-2. Metatarsi I and II with a pair of ventral spines at base. Tibiae III and IV with no spine on mid-dorsal line.

Posterior row of eyes recurved as usual, the eyes subequal and also nearly equidistant, the distance between two being a little less than the diameter of an eye. Anterior median eyes not fully their radius apart, rather closer to the subequal lateral eyes; the anterior eyes somewhat larger than the posterior; area of median eyes longer than wide and slightly wider posteriorly than anteriorly. Palpus as shown in the figures.

Male.—Total length, 5.50 mm. Length of cephalothorax, 2.50 mm.; width, 1.78 mm.

Legs:	I	II	III	IV
Coxa-trochanter.....	1.00 mm.	0.90 mm.	0.90 mm.	1.00 mm.
Femur.....	1.40 "	1.40 "	1.40 "	1.78 "
Tibia-patella.....	2.00 "	1.85 "	1.78 "	2.00 "
Metatarsus.....	1.00 "	1.00 "	1.00 "	1.60 "
Tarsus.....	0.73 "	0.70 "	0.70 "	0.78 "
 TOTAL	 6.13 mm.	 5.85 mm.	 5.78 mm.	 7.16 mm.

LOCALITY.—Arizona. Britcher collection, one male (holotype).

#### SERGIOLUS SIMON

This genus is tentatively kept apart from *Poecilochroa* on the basis of the presence of a median dorsal spine on tibia III.

#### *Sergiolus variegatus* (Hentz)

*Herpyllus variegatus* HENTZ, 1847, Jour. Bost. Soc. N. H., V, p. 456, Pl. xxiv, fig. 12.

*Sergiolus variegatus* SIMON, 1891, Proc. Zool. Soc. London, p. 573.

RECORDS.—N. C.: Black Mts., one male, Beutenmuller coll.; Transylvania Co., Toxaway Mt., one female taken June 10, 1934 (Bellamy).

#### *Sergiolus stella* Chamberlin

*Sergiolus stella* CHAMBERLIN, 1922, Proc. Biol. Soc. Wash., XXXV, p. 152.

RECORD.—Texas: Brownsville, one female taken March 16, 1923.

*Sergiolus* species

RECORD.—Montana: Ravalli Co., one immature specimen of uncertain species.

*Sergiolus bebius*, new species

## Figure 13

FEMALE.—Cephalothorax and legs with integument chestnut in color, the distal joints of legs lighter, and the femora more or less dusky. The carapace and other parts with erect or suberect setae and a dense coat of fine appressed, plumose white hair. Abdomen with integument grayish brown, densely clothed with plumose white hair and bearing the usual setae which are most conspicuous on the anterior face.

Anterior tarsi and metatarsi scopulate; tarsi III and IV also scopulate, but not the corresponding metatarsi. Tibiae I and II armed ventrally with 0-1-1 spines, the corresponding metatarsi with a ventral spine at base.

Posterior row of eyes gently recurved; eyes subequal and nearly equidistant, separated by about the diameter of an eye. Anterior median eyes smaller than the laterals (diameters ad 7:9), their radius apart, closer to the laterals. Area of median eyes longer than wide (ad 10:9) and wider behind than in front (ad 9:8). Lateral eyes on each side separated by the diameter of the anterior eye or slightly more, Epigynum as shown in the figure.

Female.—Total length, 8.20 mm. Length of cephalothorax, 3.80 mm.; width, 2.50 mm.

Legs:	I	II	III	IV
Coxa-trochanter.....	1.60 mm.	1.45 mm.	1.45 mm.	1.60 mm.
Femur.....	2.13 "	2.00 "	1.90 "	2.27 "
Tibia-patella.....	2.50 "	2.40 "	2.27 "	2.70 "
Metatarsus.....	1.12 "	2.12 "	1.30 "	2.18 "
Tarsus.....	0.80 "	0.80 "	0.80 "	1.12 "
• TOTAL	8.15 mm.	8.77 mm.	7.72 mm.	9.87 mm.

LOCALITY.—Colorado: Red Rock Range, west of Boulder, July 6, 1908, female holotype, F. E. Lutz coll.

*Sergiolus clarus*, new species

## Figures 20 and 21

MALE.—Carapace and chelicerae dusky chestnut, nearly black; sternum endites, labium and coxae of legs dusky over yellow, nearly solid black. Anterior legs beyond coxae yellow. Third legs with femur black; the tibia and metatarsus dusky, the patella partially so, and the tarsus yellow. The left fourth leg of the holotype, which apparently is regenerated, is entirely yellow beyond the femur. Integument of abdomen nearly black above.

Tarsi of legs I and II rather weakly scopulate, the metatarsus not scopulate. Tibiae I and II with ventral spines 0-0-1, otherwise unarmed; the corresponding metatarsi with a single ventral spine at base.

Posterior row of eyes slightly recurved; median eyes oblique, their long axes converging cephalad, separated by their longer radius, nearly the same distance from the laterals. Anterior median eyes smaller than the laterals, their radius or scarcely more apart closer to the laterals. Area of median eyes a little longer than wide; wider behind than in front (ad 6:5).

Male.—Total length, 3.86 mm. Length of cephalothorax, 1.60 mm.; width, 1.10 mm.

Legs:	I	II	III	IV
Coxa-trochanter.....	0.90 mm.	0.82 mm.	0.82 mm.	1.00 mm.
Femur.....	1.10 "	1.00 "	0.90 "	1.25 "
Tibia-patella.....	1.50 "	1.23 "	1.10 "	1.72 "
Metatarsus.....	0.68 "	0.64 "	0.68 "	1.27 "
Tarsus.....	0.50 "	0.50 "	0.54 "	0.54 "
TOTAL	4.68 mm.	4.19 mm.	4.04 mm.	5.78 mm.

LOCALITY.—Utah: Clear Creek Canyon, near Richfield, June 15, 1930, W. J. Gertsch, collector, male holotype.

### *Sergiolus tribolus*, Chamberlin

#### Figure 15

*Sergiolus tribolus* CHAMBERLIN, 1922, Proc. Biol. Soc. Wash., XXXV, p. 153.

MALE.—Carapace, chelicerae, and legs yellowish brown, the sternum yellow. Abdomen above black, with a white transverse stripe across middle which is divided at median line; venter a little lighter in middle region behind furrow and especially in front of the furrow; spinnerets black.

Tarsi and metatarsi I and II scopulate. Tarsi III and IV more sparsely scopulate. Tibia I with ventral spines 1-1-2, a single spine on anterior face toward base. Tibia II with ventral spines 1-2(1)-2, and a single spine on anterior face toward distal end.

Posterior row of eyes obviously recurved; eyes subequal, the medians nearly their diameter from the laterals, and four-fifths as far from each other. Anterior median eyes nearly equal in size to the laterals, about their radius apart, and subcontiguous with the laterals. Area of median eyes scarcely longer than wide, as wide in front as behind. Male palpal organ as shown in the drawings.

Length, 4.63 mm. Length of cephalothorax, 2.28; width, 1.21 mm. Length of tibia + patella I, 1.75 mm. Length of tibia + patella IV, 2.10 mm.

LOCALITY.—Florida: Gainesville, one male. Previously known only from the male holotype which was taken at Punta Gorda, and a male taken at Runnymede.

### *Sergiolus decipiens* Chamberlin

#### Figure 14

*Sergiolus decipiens* CHAMBERLIN, 1922, Proc. Biol. Soc. Wash., XXXV, p. 151.

Carapace, sternum, and chelicerae brownish yellow, the legs a shade lighter. Hair clothing as usual. Abdomen black above, with a white cross-band at anterior

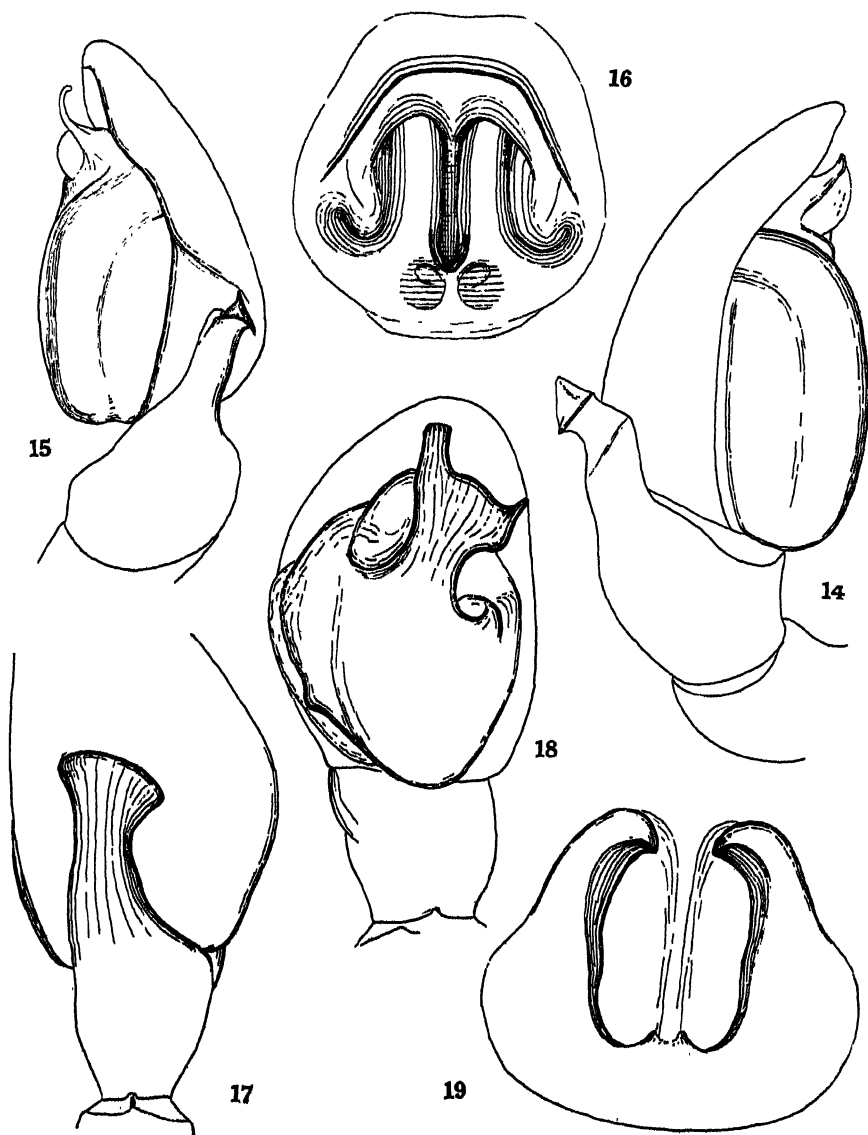


Fig. 14. *Sergiolus decipiens* Chamberlin, right palpus of male, ectal view (para-type from Pennsylvania).

Fig. 15. *Sergiolus tribolus* Chamberlin, left palpus of male, ectal view.

Fig. 16. *Nodocion barbaranus* Chamberlin, epigynum (holotype).

Fig. 17. *Haplodrassus uncifer*, new species, left palpus of male, subdorsal view of tibial apophysis, etc.

Fig. 18. *Idem*, left palpus of male, ventral view.

Fig. 19. *Idem*, epigynum.



end which is nearly divided at middle line, a white cross-band at middle and between these two cross-bands a pair of white spots; venter pale in front of genital furrow, and in middle region behind but latter area dusky, black at sides. Spinnerets pale at tips.

Anterior tarsi and metatarsi scopulate; posterior metatarsi not at all scopulate, but tarsus II sparsely scopulate, tarsus IV with only the distal bunch of scopular hairs below claws. Tibia I with no ventral spines. Metatarsi I and II with a pair of subbasal ventral spines. Tibia II with a submedian ventral spine toward anterior side. Tibia III with the usual middorsal spine at base.

Posterior row of eyes distinctly recurved; eyes equal in size or nearly so, the medians scarcely three-fifths their radius apart, farther from laterals (cir. four-fifths their diameter). Anterior median eyes smaller than the laterals (cir. 5:6), about their radius apart, closer to the laterals. Area of median eyes as wide as long or very nearly so, and as wide behind as in front. Palpus as shown in the figures.

Length, 4.20 mm. Length of cephalothorax, 2.00 mm.; width, 1.23 mm. Length of tibia + patella I, 1.54; of tibia + patella IV, 1.85 mm.

LOCALITY.—Florida: Lakeland, one male. Previously known from North Carolina (type loc., Pennsylvania, Texas, and California).

#### NODOCION CHAMBERLIN

##### *Nodocion barbaranus* Chamberlin

##### Figure 16

*Nodocion barbaranus* CHAMBERLIN, 1922, Proc. Biol. Soc. Wash., XXXV, p. 154.

FEMALE.—Carapace, chelicerae, sternum, and legs light chestnut, the labium, and coxae and femora beneath more brown, endites distally yellowish. Abdomen dark brownish gray or almost black above and laterally, the venter dusky yellow with epigynum reddish; spinnerets dusky.

Posterior row of eyes slightly procurved, clearly longer than the anterior row (7:6); median eyes angularly orbicular, somewhat narrowed at caudomesal end distinctly separated from each other but by less than a radius, an equal distance from the laterals, than which they are a little larger (diameter about as 10:9). Anterior row of eyes strongly procurved as usual; median eyes decidedly smaller than the laterals (5:4), a little less than three-fourths their diameter apart, closer to the laterals. Area of median eyes wider behind than in front (cir. 6:5), very slightly longer than wide behind. Anterior lateral eyes their diameter from lower margin of clypeus, obviously larger than the posterior laterals (cir. 5:4) from which separated by the radius of the latter.

Lower margin of the furrow of chelicerae without teeth; teeth of upper margin more or less fused together, the apices of three or four usually distinguishable.

Tibiae I and II unarmed beneath, the corresponding metatarsi with a pair of subbasal spines. Posterior tibiae with no median dorsal spines.

Anterior spinnerets with four large spiny tubules in the posterior transverse series. The epigynum figured is of the holotype.

Length, 7.00 mm. Length of cephalothorax, 3.10; width, 2.25 mm. Tibia + patella I, 2.5 mm.; tibia + patella IV, 3.00 mm.

RECORDS.—California: Los Angeles, two females.—Arizona: Scotts-

dale, one female taken by Britcher, Dec. 3, 1902; Tucson, one female taken in Aug., 1935, by P. Steckler. This species was previously known only from the holotype which was taken at Santa Barbara.

**Nodocion iugans** Chamberlin

*Nodocion iugans* CHAMBERLIN, 1922, Proc. Biol. Soc. Wash., XXXV, p. 154.

RECORD.—California: Los Angeles, one male taken Nov.–Dec., 1933, by G. Grant, and one male, same data but without date. Previously known from the holotype which was taken at Santa Barbara.

**MEGAMYRMECION** REUSS

**Megamyrmecion naturalisticum** Chamberlin

*Megamyrmecion naturalisticum* CHAMBERLIN, 1924, Proc. Cal. Acad. Sci. (4) XII, p. 617, Figs. 54, 55.

RECORD.—Arizona(?): one male in Britcher collection. Previously known from San Luis Isl., Gulf of California.

**GNAPHOSA** LATREILLE

**Gnaphosa gigantea** Keyserling

*Gnaphosa gigantea* KEYSERLING, 1887, Verh. zool.-bot. Gesell. Wien, XXXVII, p. 424, Fig. 3.

*Gnaphosa conspersa* THORELL, 1877, Bull. U. S. Geol. Survey, III, p. 489.

*Gnaphosa distincta* BANKS, 1901, Proc. Acad. Sci. Phila., p. 572 (not *distincta* Banks, 1898).

RECORDS.—Colorado: Estes Park, one female, taken July 5, 1913; Cascade, two females, D. M. Fisk coll.; Aspen, a male and a female; July 24–27, 1919; Boulder Canyon, one female, July 23, 1908; Ward, one female, Lutz coll., July 18, 1908.—Utah: Monroe Canyon, two females, Aug. 24–25, 1930, Gertsch coll.—Wyoming: Stewart, one female, July, 1920. Also two females in Britcher coll., one with no location, the other labeled “Powells,” but place uncertain.

**Gnaphosa brumalis** Thorell

*Gnaphosa brumalis* THORELL, 1875, Proc. Bost. Soc. N. H., XVII, p. 497.

*Gnaphosa scudderi* THORELL, 1877, Bull. U. S. Geol. Survey, III, p. 491.

*Gnaphosa humilis* BANKS, 1892, Proc. Acad. Sci. Phila., p. 19, Pl. I, fig. 9.

RECORDS.—Arizona(?): two females, Britcher coll.—Colorado: Camp Creek R. Sta., June 19, 1920, one female.

**Gnaphosa hirsutipes** Banks

*Gnaphosa hirsutipes* BANKS, 1901, Proc. Acad. Sci. Phila., p. 571, Pl. XXXIII, fig. 4.

RECORDS.—Arizona: Scottsdale, a mature male and female and several immature specimens in broken condition, Britcher coll., Dec. 30, 1902; Kaibab Forest, one female, W. J. Gertsch coll., July 10, 1931.—Colorado: Stoneham, Pawnee Buttes, a male and an unusually small female taken by M. Koerner.

**Gnaphosa californica** Banks

*Gnaphosa californica* BANKS, 1904, Proc. Cal. Acad. Sci., (3) III, p. 335, Pl. XXXVII, fig. 10.

RECORD.—California: Santa Monica, one female.

**CYLPHOSA CHAMBERLIN**

**Cylphosa gosoga** (Chamberlin)

*Gnaphosa gosoga* CHAMBERLIN, 1928, Proc. Biol. Soc. Wash., XLI, p. 178.

*Cylphosa gosoga* CHAMBERLIN, 1933, Amer. Mus. Novitates, No. 631, p. 2.

RECORD.—Utah: Tooele Canyon, one male taken Aug. 29, 1931, by W. J. Gertsch. Previously known from Emery Co. and Piute Co., Utah.

**Cylphosa sericata** (L. Koch)

*Pythonissa sericata* L. KOCH, 1866, 'Drassiden,' p. 31, Pl. II, fig. 21.

*Herpyllus bicolor* HENTZ, 1847, Jour. Bost. Soc. N. H., V, p. 456, Pl. XXIV, fig. 4.

RECORD.—Colorado: Boulder, July 16, 1908, one female, F. E. Lutz coll.; Valmont Butte, east of Boulder, July 25, 1908, one male, F. E. Lutz coll.—New York: Cold Spring Harbor, two males, taken June 25, 1903.

**CALLILEPIS WESTRING**

**Callilepis imbecilla** (Keyserling)

*Pythonissa imbecilla* KEYSERLING, 1887, Verh. zool.-bot. Gesell. Wien, XXXVII, p. 427, fig. 5.

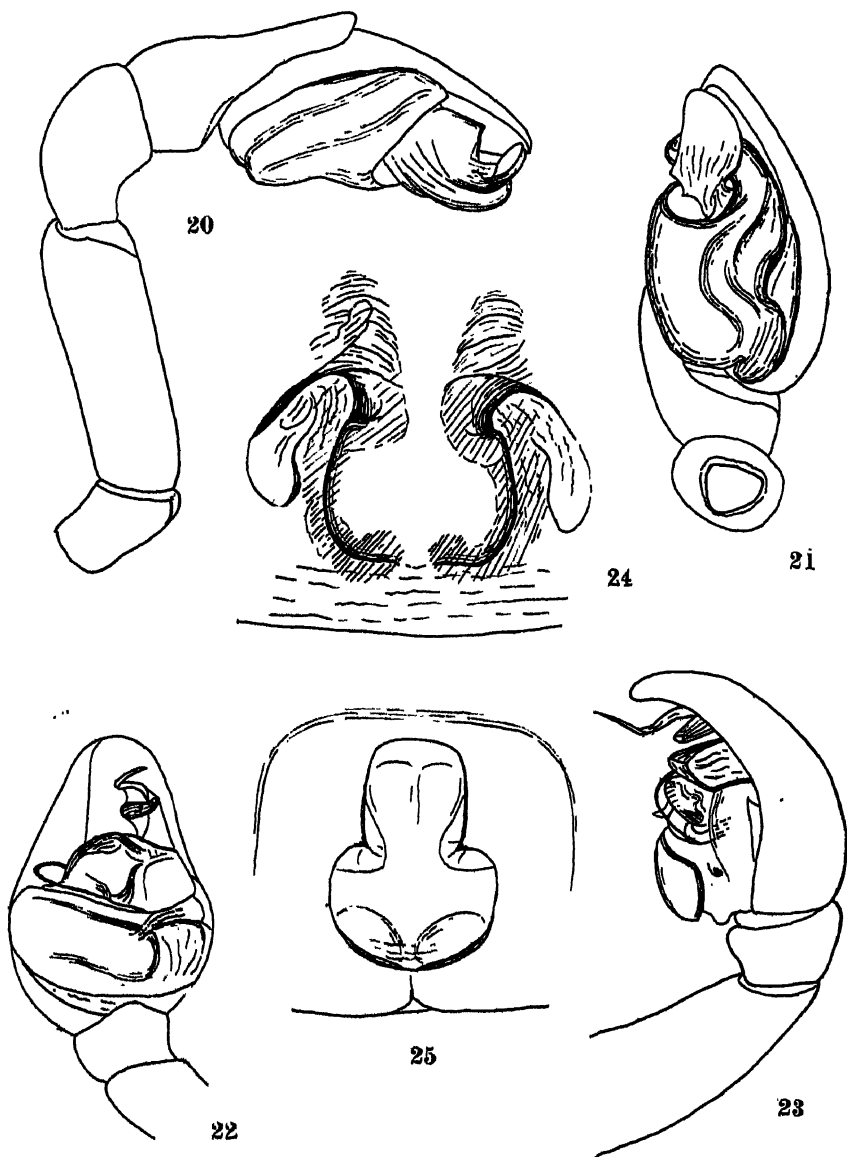
*Calliepis pluto* BANKS, 1896, Trans. Amer. Ent. Soc., XXIII, p. 60.

RECORDS.—Colorado: Valmont Butte, east of Boulder, July 25, 1908, one female, F. E. Lutz coll.—Massachusetts: Woods Hole, a male and female.

**Callilepis altitudonis**, new species

Figure 25

FEMALE.—Cephalothorax dark, somewhat dusky brown. Legs dusky or blackish over brown, except the tarsal joint which is clear yellow. Abdomen brown, without markings, the spinnerets dusky.



- Fig. 20. *Sergiolus clarus*, new species, right palpus of male, ectal view.  
 Fig. 21. Idem, right palpus of male, ventral view.  
 Fig. 22. *Callilepis munda*, new species, left palpus of male, ventral view.  
 Fig. 23. Idem, left palpus of male, ectal view.  
 Fig. 24. Idem, epigynum.  
 Fig. 25. *Callilepis altitudonis*, new species, epigynum.

Anterior tarsi sparsely scopulate along sides beneath, the corresponding metatarsi with but few scopular hairs laterally over distal part. Posterior tarsi not scopulate. Tibiae I and II with ventral spines 2-2-2, these long, those of the median and proximal pairs exceeding the diameter of the joint and the distal ones at least equalling it. Tibia III with a median dorsal spine.

Posterior row of eyes recurved; median eyes nearly transversely elongate, rather narrowly oblong, smaller than the laterals. Eyes of anterior row nearly equal, the medians about their radius apart, close to the laterals. Area of median eyes wider behind than in front. Epigynum as shown in the figure.

Total length, 5.40 mm. Length of cephalothorax, 1.67 mm.; width, 1.30 mm.

Legs:	I	II	III	IV
Coxa-trochanter.....	0.85 mm.	0.80 mm.	0.80 mm.	0.88 mm.
Femur.....	1.24 "	1.00 "	1.00 "	1.24 "
Tibia-patella.....	1.40 "	1.30 "	1.24 "	1.78 "
Metatarsus.....	0.70 "	....	0.70 "	1.67 "
Tarsus.....	0.70 "	0.65 "	0.70 "	0.90 "
TOTAL	4.89 mm.	3.75 mm.	4.44 mm.	6.47 mm.

LOCALITY.—Colorado: Estes Park, one female (holotype) taken Aug. 5, 1913, by Dr. Lutz.

### *Callilepis munda*, new species

Figures 22, 23, and 24

Carapace and sternum pale, dilute yellowish white with anterior portion of cephalic region dusky. Legs also pale excepting the femora of the first two pairs, which are dusky. Abdomen above dusky to black excepting the anterior region in the male which is whitish and is followed by a somewhat darker broad stripe extending back to the middle; in the female allotype, there is a dusky saggitate mark enclosed in the pale area. The venter in the male holotype is entirely pale but in the male allotype it is dusky behind the genital furrow.

Anterior tarsi with sparse scopular hairs along sides beneath, the posterior tarsi lacking these. Tibia III with a median dorsal spine toward base. On tibia I beneath there is a submedian pair of spines, these pale, slender, and about equal in length to the diameter of the joint (female), or shorter (male), other spines not detected.

Posterior row of eyes a little recurved; median eyes oblong, obliquely transverse, smaller than the laterals. Anterior median eyes smaller than the laterals, farther from each other than from the latter. Area of median eyes wider behind than in front and about as wide behind as long. Palpus of male and epigynum of female as shown in the figure.

Length of female, 3.80 mm. Length of cephalothorax, 1.50 mm.; width, 1.00 mm.

Length of male, 2.50 mm. Length of cephalothorax, 1.35 mm.; Tibia + patella I, 1.35 mm.

LOCALITIES.—Arkansas: Hempstead County, May, male holotype,

female allotype, and male paratype in the collection of the University of Utah.—Texas: Edinburg, June 2, 1935, male paratype (S. Mulaik); thirty miles west of Edinburg, July 4, 1935, male and female paratypes (S. Mulaik); southwest Hidalgo County, July 2, 1934, three female paratypes (S. Mulaik).

#### DRASSODES WESTRING

##### *Drassodes neglectus* (Keyserling)

*Drassus neglectus* KEYSERLING, 1887, Verh. zool.-bot. Gesell. Wien, XXXVII, p. 434.

*Drassus saccatus* EMERTON, 1889, Trans. Conn. Acad., VIII, p. 178, Pl. 4, fig. 7.

*Drassus inornatus* BANKS, 1895, Ann. N. Y. Acad., VIII, p. 420.

RECORDS.—Arizona(?): several females in the Britcher coll.—Colorado: Mancos, July 3–7, 1919, one female, F. E. Lutz coll.—New York: near Syracuse, one female, Britcher coll.—Maine: Houlton, Sept., 1902, one female.—Utah: Fish Lake, Aug., 1930, one female, W. J. Gertsch coll.

#### GEODRASSUS CHAMBERLIN

##### *Geodrassus auriculoides* (Barrows)

*Drassodes auriculoides* BARROWS, 1919, Ohio Jour. Sci., XIX, p. 355, Pl. xv, figs. 4a–4b.

*Geodrassus auriculoides* CHAMBERLIN, 1922, Proc. Biol. Soc. Wash., XXXV, p. 160.

RECORD.—New York: Saugerties, Sept. 1, 1911, one male.

##### *Geodrassus* species

RECORD.—Colorado: Red Rock Range, west of Boulder, one immature specimen taken July 7, 1908, F. E. Lutz coll.

#### HAPLODRASSUS CHAMBERLIN

##### *Haplodrassus hiemalis* (Emerton)

*Drassus hiemalis* EMERTON, 1909, Trans. Conn. Acad. Sci., XIV, p. 218, Pl. ix, fig. 1.

*Haplodrassus hiemalis* CHAMBERLIN, 1922, Proc. Biol. Soc. Wash., XXXV, p. 161.

RECORDS.—Arizona(?): one immature female in Britcher coll.—Colorado: Corona, Aug. 17, 1919, one female taken by H. F. Schwarz.

##### *Haplodrassus signifer* (C. Koch)

*Drassus signifer* C. KOCH, 1839, 'Die Arachniden,' VI, p. 31, Pl. CLXXXVIII, fig. 452.

*Drassus troglodytes* C. KOCH, idem, p. 35, Pl. CLXXXIX, figs. 455 and 456.

*Drassus clavator* CAMBRIDGE, 1860, Ann. Mag. Nat. Hist., (3) V, p. 171.

*Drassus robustus* EMERTON, 1889, Trans. Conn. Acad., VIII, p. 179, Pl. iv, fig. 8.

*Drassus placidus* BANKS, 1893, Trans. Amer. Ent. Soc., XXIII, p. 63.

*Teminius nigriceps* BANKS, 1895, Ann. N. Y. Acad., VIII, p. 421.

*Zelotes decepta* BANKS, 1900, Proc. Phila. Acad. Sci., p. 531.

*Zelotes pacifica* BANKS, 1904, Proc. Cal. Acad. Sci., (3) III, p. 336, Pl. xxxix, fig. 15.

*Haplodrassus signifer* CHAMBERLIN, 1922, Proc. Biol. Soc. Wash., XXXV, p. 162.

RECORDS.—Arizona: Kaibab Forest, July 16, 1931, one female, W. J. Gertsch coll.; also a female in Britcher coll., probably from Arizona.—Colorado: Golden, one female taken by C. H. Moss, June 13, 1933.

### *Haplodrassus uncifer*, new species

Figures 17, 18, and 19

FEMALE.—Carapace yellow of a reddish tinge anteriorly. Chelicerae light chestnut. Sternum and legs yellow. Abdomen gray, paler beneath, and yellow in front of furrow excepting the reddish epigynum.

Posterior row of eyes procurved; median eyes oblique rather less than a third their diameter apart (about four-sevenths their diameter) from the laterals, a little larger than the laterals. Anterior median eyes nearly two-thirds their diameter apart, much closer to the laterals, their diameter about three-fourths that of the latter. Anterior row of eyes decidedly shorter than the posterior (cir. 6:7). Lateral eyes on each side separated by about the radius of a posterior one. Area of median eyes as wide behind as in front and equal in length to width.

Tibia I and II with no ventral spines. Metatarsi I and II with the usual pair of subbasal ventral spines. Posterior tibiae with no median dorsal spines.

MALE.—Coloration and spines of legs as described for female. Palpus as shown in figure.

Female.—Length, 7.00 mm. Length of cephalothorax, 2.10 mm., width, 1.66 mm. Tibia + patella I, 1.90 mm.; tibia + patella IV, 2.00 mm.

Male.—Length, 4.50 mm. Length of cephalothorax, 2.37 mm.; width, 1.90 mm. Tibia + patella I, 2.00 mm.; tibia + patella IV, 2.00 mm.

LOCALITY.—Utah: Marysvale Canyon, two males (holotype and paratype) and two females (allotype and paratype) taken by W. J. Gertsch, July 21, 1930.

### ZELOTES GISTL

#### *Zelotes subterreaneus* (C. Koch)

*Melanophora subterreanea* C. KOCH, 1839, 'Die Arachniden,' VI, p. 85, Pl. cci, figs. 491 and 492.

*Herpyllus ater* HENTZ, 1832, Amer. Jour. Sci., XXI, p. 102.

*Prosthesima melancholic* THORELL, 1877, Bull. U. S. Geol. Survey, III, p. 493.

*Zelotes ater* COMSTOCK, 1912, 'Spider Book,' p. 316.

RECORDS.—Arizona(?): a male and three females in Britcher coll., also a male labeled "Crow Hill."—California: Santa Monica, two males and an immature female.—Colorado: Pikes Peak Canyon, a female taken July 21, 1908; Boulder, a female taken July 24, 1908; Boulder Canyon, a female taken by Dr. Lutz, June 23, 1908; Electra Lake, a female taken July 1, 1919; Eldora, a female and an immature specimen taken July 1, 1909, all F. E. Lutz coll.—Idaho: Adelaide, four specimens taken Sept., 1931, by D. E. Fox; Bloomington, five specimens, males and females, taken Aug. 14, 1931, by W. J. Gertsch.—Utah: Richfield, two females taken July–Aug., 1930, by Gertsch; Monroe Canyon, a female taken by Gertsch, Aug. 25, 1930; Fish Lake, a female and two immature specimens taken by Gertsch, June 22, 1930.—New Hampshire: Bay St. George, a male taken by W. M. Wheeler, July 10, 1912.—Wyoming: Stewart, a male taken by Lutz, July 18, 1918.—Texas: seven miles east of Edinburg, three males and two females, taken by S. Mulaik, Oct. 12, 1934.

#### *Zelotes funestus* (Keyserling)

*Prosthesima funesta* KEYSERLING, 1887, Verh. zool.-bot. Gesell. Wien, XXXVII, p. 431, Pl. VI, fig. 8.

RECORDS.—California: Santa Monica, three females; Los Angeles, Nov.–Dec., 1922, a female and a male, taken by G. Grant.

#### *Zelotes puritanus* Chamberlin

*Telotes puritanus* CHAMBERLIN, 1922, Proc. Biol. Soc. Wash., XXXV, p. 164.

RECORDS.—Colorado: Boulder Canyon, July 22, 1908, a female, Lutz coll.—Utah: Puffer Lake, a female taken July 3, 1931, by Gertsch; Tooele Canyon, one female, Aug. 29, 1931 (Gertsch).

#### *Zelotes omisus*, new species

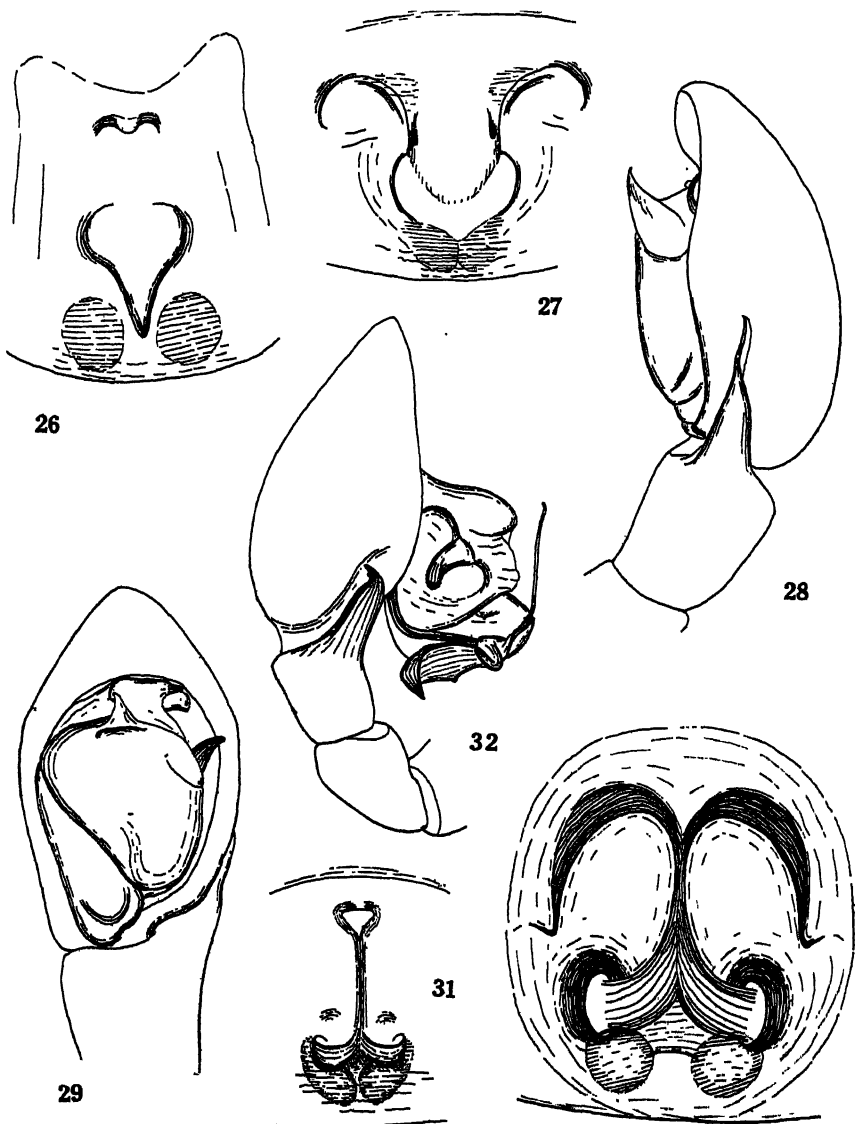
##### Figure 26

FEMALE.—Carapace, sternum, and legs chestnut, the abdomen brown, without markings.

Tarsi and metatarsi of legs I and II scopulate, those of III and IV simply setose. Tibiae I and II without spines. Metatarsus I unarmed; metatarsus II with a pair of ventral spines at base. Tibiae III and IV with no median dorsal spines.

Posterior row of eyes straight or nearly so; median eyes as large as the laterals or nearly so, a little less than their diameter apart, a little closer to the laterals. Anterior row of eyes shorter than posterior row in about the ratio 3:4; procurved; median eyes much smaller than the laterals (diameters about 5:9), nearly their





- Fig. 26. *Zelotes omissus*, new species, epigynum.  
 Fig. 27. *Drassyllus adocetus*, new species, epigynum.  
 Fig. 28. *Drassyllus amissus*, new species, left palpus of male, ectal view.  
 Fig. 29. *Idem*, left palpus of male, ectal view.  
 Fig. 30. *Drassyllus conformans*, new species, epigynum.  
 Fig. 31. *Drassyllus fratrellus*, new species, epigynum.  
 Fig. 32. *Idem*, right palpus of male, expanded, ectal view.

diameter apart, very close to the laterals. Area of median eyes a little longer than wide posteriorly, wider behind than in front in about the ratio 17:13. Posterior lateral eyes smaller than the anterior laterals (diameters ad 7:9), the laterals on each side separated by a distance less than the diameter of a posterior one.

Lower margin of furrow of chelicerae with two teeth; the upper margin with five teeth of which the next to the most proximal one is much larger than the others. Epigynum as shown in the figure.

FEMALE.—Total length, 6.80 mm. Length of cephalothorax, 3.40 mm.; width, 2.27 mm.

Legs:	I	II	III	IV
Coxa-trochanter.....	1.80 mm.	1.60 mm.	1.40 mm.	1.90 mm.
Femur.....	2.20 "	1.90 "	1.72 "	2.20 "
Tibia-patella.....	2.72 "	2.50 "	2.18 "	3.40 "
Metatarsus.....	1.36 "	1.22 "	1.36 "	2.27 "
Tarsus.....	1.00 "	0.90 "	0.80 "	1.00 "
TOTAL	9.08 mm.	8.12 mm.	7.46 mm.	10.77 mm.

LOCALITY.—California: Los Angeles, Nov.-Dec., 1922, G. Grant collection, one female (holotype).

#### DRASSYLLUS CHAMBERLIN

This genus is proving to be a very large one. The taxonomic problem presented is unfortunately complicated by the fact that specimens representing the different species largely come to hand singly or as representatives of one sex only, so that the bringing together of the sexes of the same species is often difficult or impossible at this stage of our knowledge.

#### *Drassyllus adocetus*, new species

##### Figure 27

FEMALE.—Carapace brown, dusky at margin and in reticular markings on head and sides. Sternum and legs more yellow. Abdomen gray or somewhat brownish gray, paler beneath, the spinnerets yellowish.

Posterior row of eyes distinctly procurved; median eyes oblique and moderately elongate as usual, decidedly narrow at mesocaudal end, very narrowly separated and a little farther from the laterals as usual, their longer diameter exceeding that of the laterals nearly as 3:2. Anterior median eyes about four-fifths the diameter of the laterals, nearly their radius apart, but subcontiguous with the laterals. Anterior row conspicuously procurved as usual, a little shorter than the posterior row (ad 15:16). Area of median eyes as wide in front as behind, a little longer than wide (10:9).

Tibiae I and II with no ventral spines.

Upper margin of furrow of chelicera with five teeth, the lower with three which are distinctly developed.

Tubules of anterior spinnerets four.

Total length, 5.50 mm. Length of cephalothorax, 2.16 mm.; width, 1.60 mm. Length of tibia + patella I, 2.16 mm.; tibia + patella IV, 2.50 mm.

LOCALITY.—Long Island: Rockaway Park, April 4, 1909, two females, of which the holotype is in The American Museum of Natural History, and the paratype at the University of Utah.

***Dryssyllus amissus* Chamberlin, new species**

Figures 28 and 29

MALE.—Carapace, chelicerae, sternum, and legs yellow, the carapace with a black marginal line and reticulation of dark line on pair cephalica. Abdomen above nearly black except a subtriangular pale area at base; beneath dusky over yellow, more yellow in front of the furrow.

Posterior row of eyes procurved; the medians large and suborbicular, narrower toward mesocaudal edge, contiguous or nearly so and narrowly separated from the laterals, much larger than the laterals (diameters cir. 4:3). Anterior row of eyes strongly procurved; median eyes smaller than the laterals, about their radius or slightly more, apart, close to the laterals. Area of median eyes slightly wider behind than in front (15:14) and a little longer than wide.

Tibia I without spines; tibia II with a single submedian ventral spine; metatarsi I and II with a pair of ventral spines toward proximal end. Posterior tibiae with no median spine above. Tarsi not truly scopulate except for a few tenent hairs at distal end and in anterior pair.

Upper margin of furrow of chelicera with two distinct teeth and a third small or nodular one at distal end of series; lower margin with three smaller, nodular teeth.

Total length, 4.35 mm. Length of cephalothorax, 2.00 mm., width, 1.50 mm. Tibia + patella I, 2.00 mm.; tibia + patella IV, 2.08 mm.

LOCALITY.—Arizona: male holotype and two male paratypes in the Britcher collection.

***Drassylus aprilinus* (Banks)**

*Zelotes aprilinus* BANKS, 1904, Jour. N. Y. Ent. Soc., XII, p. 110, Pl. v, fig. 7.

*Drassylus aprilinus* CHAMBERLIN, 1922, Proc. Biol. Soc. Wash., XXXV, p. 170.

RECORD.—New Jersey: Lakehurst, May 1, 1912, one female taken by J. H. Emerton.

***Drassylus conformans*, new species**

Figure 30

FEMALE.—Carapace brown, black in a V-shaped mark at posterior angle of head and in partially anastomosing dark lines over head and down sides of thorax, the margin of carapace also black. Legs brownish yellow excepting the first two pairs; the first two legs are black over patella, tibia, and distal portion of femur. Sternum yellow. Abdomen black, a little paler in middle part of venter.

Posterior row of eyes distinctly procurved, scarcely or not at all longer than the anterior row; median eyes large, irregularly ovate with the broad end ectocephalad, only slightly separated from each other and but little farther from the

laterals, much larger than the circular laterals. Anterior median eyes nearly their diameter apart, closer to laterals than which they are smaller.

Tibiae I and II without spines beneath, the corresponding metatarsi with a pair of ventral spines between middle and base. Tarsi I and II rather sparsely scopulate, the posterior tarsi not scopulate; tibiae III and IV without a median dorsal spine.

Upper margin of furrow of chelicera with five teeth of which the most proximal and most distal are smallest, and the next to the most proximal largest, the middle three all stout; lower margin with three teeth.

Fore spinnerets each with four of the long, cylindrical spinning tubules with truncate apex.

Total length, 5.20 mm. Length of cephalothorax, 1.80 mm.; width, 1.28 mm. Length of tibia + patella I, 1.35 mm.; of tibia + patella IV, 1.80 mm.

LOCALITY.—California: Santa Monica, one female (holotype).

### **Drassyllus depressus (Emerton)**

*Prothesima depressa* EMERTON, 1909, Trans. Conn. Acad., VIII, p. 173, Pl. III, fig. 8.

*Drassyllus depressus* CHAMBERLIN, 1922, Proc. Biol. Soc. Wash., XXXV, p. 167.

RECORDS.—Colorado: Boulder Canyon, one female taken July 15, 1908 (Lutz).—Arizona (?): two females in the Britcher coll.—New York: Kingston, a male taken June 26, 1909, by I. F. Barnum.

### **Drassyllus rufulus (Banks)**

*Prothesima rufula* BANKS, 1892, Proc. Acad. Phila., p. 17, Pl. I, fig. 55.

*Prothesmia immaculata* (BANKS), idem, p. 18, Pl. I, fig. 58.

*Drassyllus rufulus* CHAMBERLIN, 1922, Proc. Biol. Soc. Wash., XXXV, p. 167.

RECORDS.—New York: Pompey, two females, Sept. 28, 1900, and one labeled simply "N. Y.," Britcher coll. Also three females in Britcher coll. without any locality, and one labeled "Vesper Hill."—Pennsylvania: North Mountain, Sept., 1909, one female.

### **Drassyllus dromeus Chamberlin**

*Drassyllus dromeus* CHAMBERLIN, 1922, Proc. Biol. Soc. Wash., XXXV, p. 169.

RECORD.—Texas: Brownsville, one male. Previously known from the male holotype, which was taken at Austin.

### **Drassyllus fratrellus, new species**

Figures 31 and 32

FEMALE.—Carapace light brown, black on marginal line and with the usual dusky reticulations. Legs yellow excepting patella and tibia of leg I which are dusky, probably black in life. Sternum yellow. Abdomen dark gray above, paler beneath as usual. Spinnerets yellow.

Posterior row of eyes slightly procurved. Median eyes large and oblique, subovate, the caudomesal end being conspicuously narrowed, narrowly separated

and about the same distance from laterals, the diameter of the laterals about two-thirds the long diameter of the medians. Anterior row of eyes shorter than the posterior about as 9:10; median eyes about their radius apart, close to laterals, their diameter somewhat more than two-thirds that of the laterals. Area of median eyes clearly narrower in front than behind (ad 5:6). Lateral eyes on each side separated by about the radius of a posterior one.

Tibiae I and II unarmed. Metatarsus I unarmed, II with a pair of ventral spines at base.

Upper margin of furrow of chelicera with four teeth, the lower with three.

Seriate spinning tubules of anterior spinnerets four. Epigynum as figured.

MALE.—Coloration as in female. Palpus expanded, as figured.

Female.—Total length, 3.60 mm. Length of cephalothorax, 1.46 mm.; width, 1.12 mm. Tibia + patella I, 1.46 mm.; tibia + patella IV, 1.60 mm.

Male.—Total length, 2.33 mm. Length of cephalothorax, 1.16 mm.; width, 0.93 mm.

LOCALITY.—Arizona: Scottsdale, Dec. 30, 1902, Britcher coll., female holotype, female paratype, and male allotype.

### *Drassyllus frigidus* (Banks)

Figures 40 and 41

*Prothesima frigida* BANKS, 1892, Proc. Phila. Acad. Sci., p. 17, Pl. i, fig. 56.

*Prothesima nova* BANKS, 1895, Jour. N. Y. Ent. Soc., III, p. 78.

*Zelotes novus* BANKS, 1910, Bull. U. S. N. M., p. 8.

*Drassyllus frigidus* CHAMBERLIN, 1922, Proc. Biol. Soc. Wash., XXXV, p. 168.

MALE.—Carapace yellow, with black lateral margins and dusky reticulations, especially marked toward eye region. Legs, chelicerae, and sternum yellow. Abdomen dark gray or black above except the large triangular area at base which is yellow with a somewhat darker longitudinal mark enclosed; venter paler throughout. Spinnerets yellow.

Posterior row of eyes nearly straight; median eyes large, subcircular, the posterior side a little flattened, narrowly separated from each other, farther than usual from the laterals, about a radius equal to or slightly smaller than the laterals. Anterior row of eyes shorter than posterior (ad 14:15); median eyes their diameter, or nearly so, apart, much smaller than the laterals, their diameters smaller than two-thirds, or a little more, that of the laterals, the loose condition of the integument making precise measurement difficult. Area of median eyes slightly narrower in front than behind (cir. 15:16).

Tibia I unarmed. Tibia II with ventral spines 1-1-0. Metatarsi I and II each with a pair of subbasal ventral spines. No median dorsal spine on posterior tibiae.

Upper margin of furrow of chelicerae with six teeth, the lower with two (right) or three (left) in holotype.

Spinning tubules of anterior spinnerets four.

Total length, 6.00 mm. Length of cephalothorax, 2.50 mm.; width, 2.00 mm. Tibia + patella I, 2.70 mm.; tibia + patella IV, 2.70 mm.

RECORDS.—New York: Tully, two females, Oct. 17, 1900 (prob.

Britcher); Union Valley, several females and an immature male, Oct. 4, 1900 (Britcher); "Stones Onion Hill," Oct. 18 (Britcher); one male at Jonesville, May 8, 1916, Britcher coll. Also two females in the Britcher collection with no locality label.

***Drassyllus gertschi*, new species**

Figures 33 and 34

**MALE.**—Carapace dusky yellow with a distinct black marginal stripe on each side. Legs clearer yellow, with indications that the patella and tibia of first pair may be dusky or blackish when in full color. Chelicerae and sternum yellow. Abdomen black above with a scarcely lighter triangular basal area vaguely indicated; venter a little lighter, distinctly so in front of the furrow. Spinnerets yellowish.

Posterior row of eyes procurved as usual; the median eyes large, the mesal and posterior or ectoposterior sides flattened, producing a distinct caudomesal angle, subcontiguous with each other and also close to the laterals, longest diameter larger than that of the laterals nearly in ratio 8:7. Anterior row of eyes conspicuously procurved as usual, a little shorter than the posterior row (cir. 11:12); median eyes between three-fifths their diameter apart, much closer than the laterals, much smaller than the laterals (diameters cir. 5:7).

**RECORDS.**—California: Los Angeles, several specimens, male and female, Nov.-Dec., 1922 (G. Grant), and a male taken in Lake Park, collector not given.—Utah: Richfield, several females taken July-Aug., 1930, by W. J. Gertsch; Salt Lake City, several females, June-Sept., 1931, W. J. Gertsch.

***Drassyllus lutzi*, new species**

Figure 39

**FEMALE.**—Carapace light brown, legs more yellow but with patellae and tibiae of first two pairs of legs dusky or blackish. Sternum and coxae of legs yellow. Abdomen dark gray above and below, the spinnerets yellow.

Posterior row of eyes decidedly procurved, the conspicuously large median eyes somewhat angular and a little elongate in mesocaudal direction, narrowly separated from each other and from the lateral eyes, long diameter to that of laterals about as 5:4. Anterior row of eyes as long as the posterior; median eyes much smaller than the laterals (diameters as 2:3), two-thirds their diameter apart, close to the laterals. Area of median eyes wider behind than in front in the ratio 6:5, slightly longer than wide behind.

Tibia I with no ventral spines. Tibia II with two ventral spines in line, one at middle and one at base. Metatarsi I and II with a pair of ventral spines toward base. Posterior tibiae without a median dorsal spine.

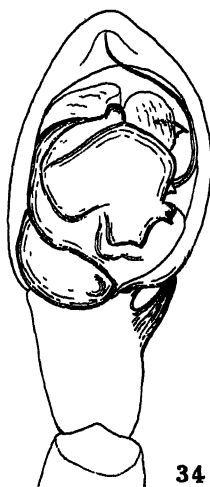
Upper margin of furrow of chelicera with four teeth, the lower with three of which the most distal is smallest.

Large spinning tubules of anterior spinnerets in a transverse series of four.

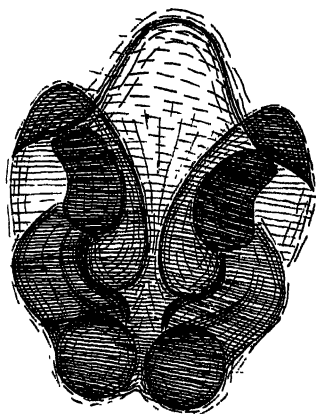
Total length, 6.00 mm. Length of cephalothorax, 2.40 mm.; width, 1.80 mm. Tibia and patella I, 2.40 mm.; tibia and patella IV, 2.80 mm.



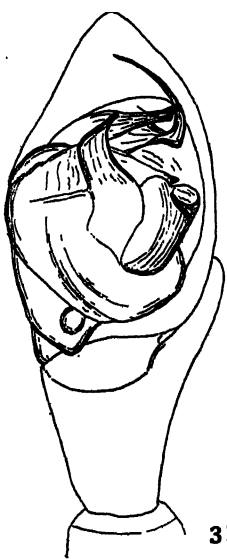
33



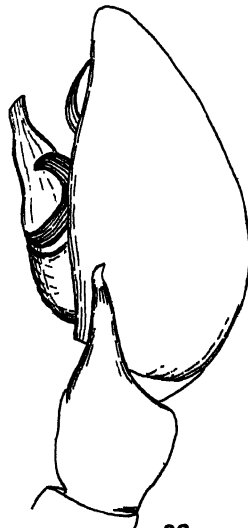
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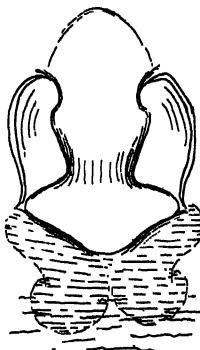
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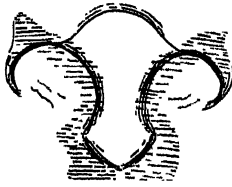
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39



35

- Fig. 33. *Drassyllus gertschi*, new species, left palp of male, ectal view.  
 Fig. 34. Idem, left palp of male, ventral view.  
 Fig. 35. *Drassyllus monicus*, new species, epigynum.  
 Fig. 36. *Drassyllus mormon*, new species, epigynum.  
 Fig. 37. Idem, left palp of male, ventral view.  
 Fig. 38. Idem, left palp of male, ectal view.  
 Fig. 39. *Drassyllus lutzi*, new species, epigynum.

LOCALITY.—Colorado: Valmont Butte, east of Boulder, one female (holotype) taken July 25, 1908 (F. E. Lutz).

**Drassyllus monicus**, new species

Figure 35

FEMALE.—Carapace, sternum, chelicerae, and legs brown. Abdomen dark gray above, lighter beneath, without markings.

Posterior row of eyes slightly procurved; median eyes large, angularly narrowed mesocaudad, only slightly separated from each other, a little farther from the laterals, clearly larger than the laterals (diameters 8:7). Anterior row of eyes shorter than the posterior (13:14); median eyes much smaller than the laterals (diameter 2:3), less than their radius apart and closer to the laterals. Lateral eyes on each side rather close together, less than the radius of a posterior one apart. Area of median eyes wider behind than in front (8:7), longer than wide behind (cir. 9:8).

Tibiae I and II without spines. Metatarsi I and II with a pair of ventral spines toward proximal end.

Upper margin of furrow of chelicera with four teeth, the lower with 2 teeth.

Anterior spinnerets with spinning tubules of posterior series six in number, two on ectal side, one of which is somewhat more weakly developed than the others.

Total length, 6.50 mm. Length of cephalothorax, 2.40 mm.; width, 1.65 mm. Tibia + patella I, 2.17 mm.; Tibia + patella IV, 2.60 mm.

LOCALITY.—California: Santa Monica, one female (holotype).

**Drassyllus mormon**, new species

Figures 36, 37, and 38

FEMALE.—Carapace, chelicerae, and sternum brown, or somewhat chestnut, the legs a little lighter shade. Abdomen gray, without markings.

Posterior row of eyes a little procurved; median eyes oblong, oblique their long diameter greater than that of the laterals nearly in ratio 5:4, about their lesser radius from each other and slightly farther from the laterals. Anterior median eyes a little smaller than the laterals (diameters about as 9:10), about their radius apart and nearly contiguous with the laterals. Area of median eyes longer than wide in ratio 5:4. Anterior lateral eyes less than their diameter from lower margin of clypeus.

Tibiae I and II without ventral spines, the corresponding metatarsi with a pair of ventral spines proximad of the middle. Anterior tarsi moderately scopulate, some scopular hairs also on metatarsi. Posterior tarsi setose, not at all scopulate. Posterior tibiae without median dorsal spines.

Lower margin of furrow of chelicera in female holotype and male allotype with two teeth, the upper with five. In the paratype the lower margin on one side has two teeth, the upper four, while on the other side the lower margin has three and the upper six. Epigynum of female as figured.

Total length of female holotype, 8.20 mm. Length of cephalothorax, 3.00 mm.; with, 2.30 mm. Tibia + patella IV, 3.33 mm. In a paratype the tibia + patella I is equal in length to the cephalothorax.

MALE.—Coloration and eyes, etc., nearly as in female. Tibia II with a median



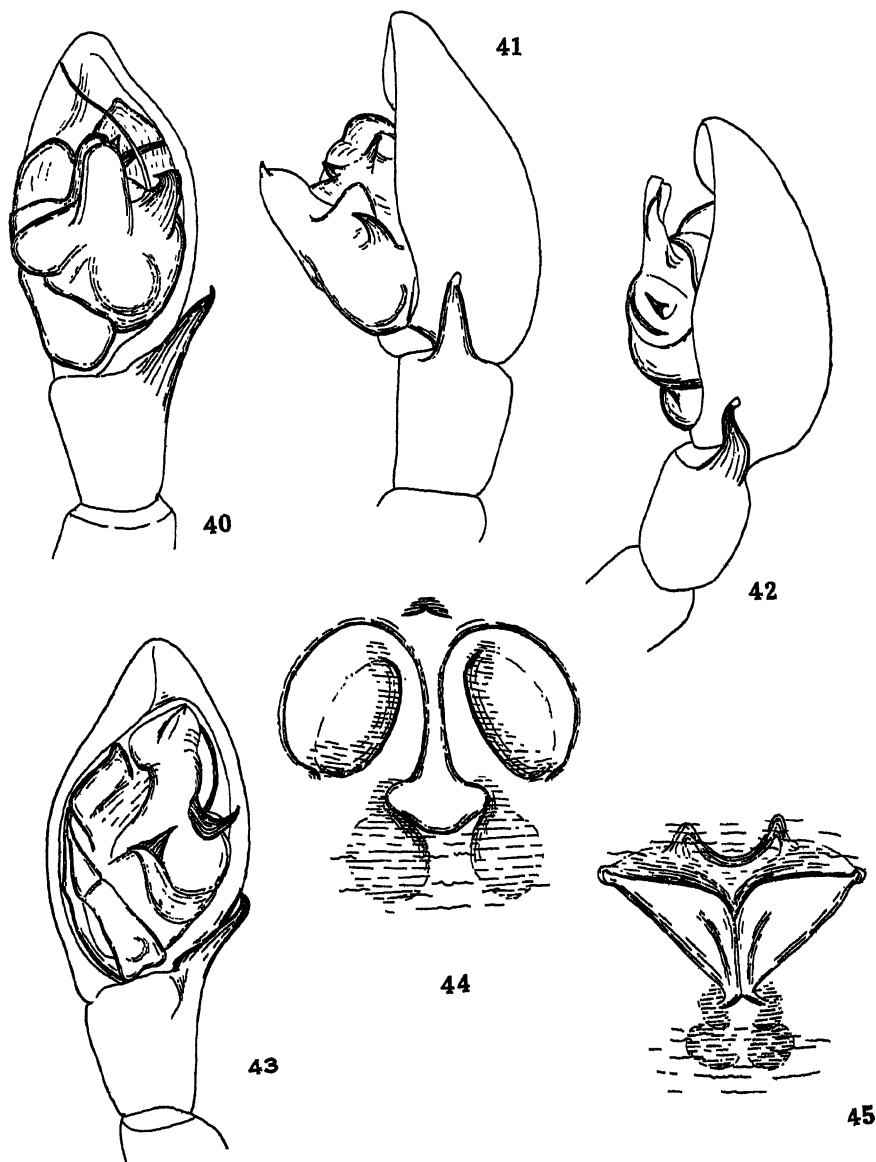


Fig. 40. *Drassyllus frigidus* (Banks), left palpus of male, ventral view.  
 Fig. 41. Idem, left palpus of male, ectal view.  
 Fig. 42. *Drassyllus ostegae*, new species, left palpus of male, ectal view.  
 Fig. 43. Idem, left palpus of male, ventral view.  
 Fig. 44. *Drassyllus saphes*, new species, epigynum.  
 Fig. 45. *Drassyllus viduus*, new species, epigynum.

ventral spine. Length of male allotype, 7.00 mm. Length of cephalothorax, 2.70 mm.; width, 2.08. Tibia + patella I, 2.65 mm.; tibia + patella IV, 2.80 mm.

LOCALITY.—Utah: St. George, female holotype, male allotype, and imperfect female paratype, Gertsch and Johnson coll., July 7, 1931.

***Drassyllus ostegae*, new species**

Figures 42 and 43

MALE.—Carapace, chelicerae, and legs yellow of dusky or brownish cast, the sternum and coxae of legs beneath clearer yellow. Abdomen above dark gray except anterior portion where yellow.

Posterior row of eyes gently procurved; median eyes large, a little suborbicular, but angularly narrowed at mesocaudal end and flattened at opposite end, only very narrowly separated from each other, several times as far from the laterals but this distance less than the radius of a lateral eye, the long diameter of the medians exceeding that of the laterals nearly as 4:3. Anterior row shorter than the second about as 15:16; median eyes their radius or somewhat less apart, clearly smaller than the laterals as usual, the diameters being about as 6:7. Anterior row of eyes slightly longer than wide (16:15) and wider behind than anteriorly as 15:14. Lateral eyes on each side separated by somewhat less than a radius of a posterior one.

Tibia I with ventral spines 0-0-0 or 0-1-0. Tibia II with ventral spines 1-1-0. Metatarsi I and II with a pair of subbasal ventral spines.

Upper margin of furrow of chelicera with four teeth, the lower with two.

Spinning tubules of anterior spinnerets four in number. Palpus as shown in figures.

Total length, 3.75 mm. Length of cephalothorax, 1.73 mm.; width, 1.37 mm. Tibia + patella I, 1.73 mm.; tibia + patella IV, 1.87 mm.

LOCALITY.—Florida: Ostega, near Jacksonville, one male (holotype) taken Nov. 3, 1911.

***Drassyllus saphes*, new species**

Figure 44

FEMALE.—Cephalothorax and legs of the usual dilute chestnut-brown color. The abdomen, in the holotype rubbed about free of hair, is light gray or whitish in color both above and below.

Posterior row of eyes slightly procurved; median eyes large, and narrowed mesocaudal as usual, much less than their radius apart, scarcely farther from the laterals, larger than the laterals (the long diameter to that of laterals nearly as 4:3). Anterior row a little shorter than the posterior (13:14); median eyes much smaller than the laterals, the diameter being about three-fourths that of the latter. Area of median eyes wider behind than in front (cir. 7:6), a little longer than wide behind (cir. 8:7). Lateral eyes on each side separated by nearly the radius of a posterior one.

Tibiae I and II without spines; metatarsi I unspined beneath, II with a pair of slender ventral spines toward base. Anterior tarsi and metatarsi scopulate as usual. No median dorsal spine on tibiae III and IV.

Upper margin of furrow of chelicera with five teeth, the lower with two nodular ones.

Spinning tubules of anterior spinnerets six.

Total length, 6 mm. Length of cephalothorax, 2.58 mm.; width, 2 mm. Tibia + patella I, 2.58 mm.; tibia + patella IV, 2.9 mm.

LOCALITY.—California: Los Angeles; one female (holotype) taken Nov.–Dec., 1927, by G. Grant.

***Drassyllus viduus*, new species**

Figure 45

FEMALE.—Specimen somewhat faded from long preservation. Carapace, chelicerae, sternum, and legs at present yellow, the carapace somewhat darker as usual, abdomen dark gray, paler beneath, the spinnerets yellow.

Posterior row of eyes gently procurved; median eyes oblique, moderately elongated, narrowly separated from each other, slightly farther from the laterals, the longer diameter exceeding that of the laterals in the ratio 5:4. Anterior median eyes scarcely more than their laterals as usual; the row procurved in the usual degree, barely shorter than the posterior one (cir. 31:33). Area of median eyes wider behind than in front (10:9), only very slightly longer than wide behind (cir. 21:20).

Tibia I unarmed beneath. Tibia II with ventral spines 1–1–0. Metatarsi I and II each with two ventral spines toward base. Posterior tibiae without a median dorsal spine.

Upper margin of furrow of chelicera with five teeth, the lower with two.

Spinning tubules of anterior spinnerets four in the usual dorsal series.

The poor condition of the tegument of the holotype has prevented a fully satisfactory representation of the epigynum, but the figure will probably be adequate for purposes of identification.

Total length, 7.00 mm. Length of cephalothorax, 2.58 mm.; width, 1.87 mm. Tibia + patella I, 2.83 mm.; tibia + patella IV, 3.00 mm.

LOCALITY.—Female holotype from Scottsdale, Arizona, Dec. 30, 1902 (Britcher collection).





# AMERICAN MUSEUM NOVITATES

Number 842

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

April 13, 1936

## THE AUSTRALIAN ANT GENUS *FROGGATTELLA*

BY WILLIAM MORTON WHEELER

Forel, in 1902, based the genus *Froggattella* on the worker of a small Australian ant, which, owing to its aberrant characters, has had a rather varied career in myrmecological literature. Originally described by Lowne as long ago as 1865 as *Acantholepis kirbyi* and therefore assigned to what is now a very different subfamily, the Formicinae, it was correctly recognized by Mayr in 1870 as a dolichoderine and placed by him in his genus *Hypoclinea*. When the members of this genus were divided between *Dolichoderus* Lund and *Iridomyrmex* Mayr, Dalla Torre, in 1893, assigned *kirbyi* to the former. According to Forel, however, dissection shows that Lowne's ant deserves to rank as the type of an independent genus, because it has a gizzard like that of *Iridomyrmex* and quite unlike that of *Dolichoderus* and possesses a more developed sting than any dolichoderine genus, except *Aneuretus* Emery. In the dolichoderine fascicle of Wytsman's 'Genera Insectorum' (1912) Emery therefore placed *Froggattella* in his tribe Tapinomini, which contains the great majority of the genera of the subfamily (*Semonius*, *Liometopum*, *Turneria*, *Dorymyrmex*, *Iridomyrmex*, *Bothriomyrmex*, *Azteca*, *Forelius*, *Engramma*, *Tapinoma*, *Zatapinoma* and *Technomyrmex*). My discovery of the female and male of *Froggattella*, while I was accompanying the Harvard Australian Expedition in 1931, yields additional proof of its relationship to *Iridomyrmex* and at the same time confirms Forel's view of its status as an independent genus. One of his characters, however, should be dropped from the generic diagnosis. I have dissected out the gizzard and sting of a number of workers and females of *Froggattella* and am able to confirm his account of the gizzard as being essentially like that of *Iridomyrmex*, but not his statement that the sting is "fort distinct à la dissection, bien plus petit que chez *Aneuretus*, mais plus fort que chez les autres genres de la sous-famille." In all my preparations the sting shows no greater development than in *Dolichoderus* (*decollatus*) or *Iridomyrmex* (*detectus*). In all three forms the parts of the sting proper, namely the palpi, sting-sheath and lancets, are nonsclerotized, small and, making allowance for the differences in size of the three species, reduced to precisely the same vestigial condition,

though the quadrate, triangular and oblong plates are clearly differentiated and in part sclerotized as in other aculeates.

#### FROGGATTELLA FOREL

FOREL, 1902, Rev. Suisse Zool., x, p. 459 ♀; EMERY, 1912, 'Genera Insectorum,' p. 20 ♀.

WORKER.—Monomorphic, with hard integument. Head subcordiform, shaped like that of *Iridomyrmex*; eyes moderately large, feebly convex, just in front of the middle of the sides; ocelli absent. Mandibles well-developed, subtriangular, with dentate masticatory and minutely denticulate basal borders. Maxillary palpi 6-jointed, labial palpi 4-jointed. Clypeus rather large, ecarinate, with entire anterior border and the posterior border broadly rounded in the middle and extending back between the frontal carinae, which are rather widely separated and subparallel. Frontal groove and sutures bounding the frontal area indistinct. Antennae 12-jointed; funiculi somewhat enlarged but not clavate at their tips; first funicular joint as long as the following two subequal joints together. Thorax slender, with pronounced, sellate mesoepinotal impression; promesonotal suture distinct, mesoepinotal suture obsolete dorsally; pronotum large, hemispherical; mesonotum long, parallel-sided with marginate mesosterna; metanotal spiracles prominent, closely approximated, projecting dorsally just in front of the deepest portion of the mesoepinotal impression; epinotum long, its base armed posteriorly with a pair of blunt, flattened, horizontal, subspatulate or subtriangular and sometimes incurved spines, which bear the epinotal spiracles on their expanded bases or even near their tips; declivity concave as in *Dolichoderus*. Petiole long, with very short anterior and very long posterior peduncle, the scale well-developed but low, thick, transverse, strongly inclined forward, fitting into the concave epinotal declivity. First gastric segment concave at the base, overlying the posterior peduncle of the petiole. Gizzard very similar to that of *Iridomyrmex*, with large, reflected calyx. Middle and hind tibiae with well-developed, pectinated spurs; tarsal claws simple.

FEMALE.—Much larger than the worker and closely resembling the female of *Iridomyrmex*. Eyes larger and more convex than in the worker; ocelli large, widely separated. Thorax elongate, the epinotum simple, without spines and with the spiracles in the usual position on the sides. Petiole stouter than in the worker, its scale much thicker, nodiform, its posterior peduncle much shorter. Gaster elongate-elliptical as in *Iridomyrmex*, the first segment narrowed and marginate anteriorly above a distinct basal cavity which overlies the peduncle. Fore wings with a long, closed submarginal cell, two large, complete cubital cells and a discoidal cell; pterostigma narrow, elongate, consisting of a darker-colored portion of the wing-membrane bounded anteriorly and posteriorly by distinct continuations of the costal and subcostal veins.

MALE.—Not larger than the worker, resembling the male of *Iridomyrmex*. Head broad, with very large, convex eyes and ocelli and very short cheeks. Mandibles small, pointed, edentate, not meeting in the middle line. Frontal carinae very short, as far apart as their distance from the lateral borders of the cheeks. Antennae short, gradually tapering toward their tips, 13-jointed, scapes very short, scarcely longer than the first funicular joint, which is not enlarged. Thorax voluminous, mesonotum without notauli (Mayrian furrows), convex anteriorly and overhanging

the short pronotum; epinotum sloping, rounded, without traces of spines. Petiole quite unlike that of the worker and female, being very small and short, nodiform, posteriorly broadly applied to the base of the subelliptical gaster, the first segment of which is narrowed anteriorly but does not overhang the petiole. Cerci present. Genitalia small, exserted. Fore wings with a long, closed submarginal cell, a discoidal cell and only a single cuboidal cell; pterostigma proportionally larger than in the female, consisting of a uniform thickening, in which the costal and subcostal veins are indiscernible.

Colonies of *Froggattella*, according to my observations, are nowhere common in Australia. Its geographical range extends from the Cape York Peninsula of Queensland to southern New South Wales and southwestward into South Australia. It probably occurs in the dryer parts of Victoria, but I have seen no specimens from that state, nor is there any record of its occurrence in Central or West Australia. Among my material I am able to distinguish at least seven different forms, six of which may be regarded as so many subspecies of *Kirbyi* since at least most of them seem to be confined to particular geographical or ecological environments. The seventh form, from Port Lincoln, South Australia, is an undescribed species (*F. latispina*, new species).

Were the worker of *Froggattella* unknown, the female and male would be assigned without hesitation to the genus *Iridomyrmex*, in which even the sexual difference in the number of cubital cells of the fore wings has been observed. The worker *Froggattella*, on the other hand, differs greatly from the female not only in its smaller size and in the structure of the thorax and petiole but also, as will be shown in the specific description (*vide infra* p. 6) in the more superficial characters of sculpture, pilosity and color. To my knowledge the only ants that exhibit strictly comparable differences are the species of *Colobopsis* (genus *Camponotus*) belonging to the Fijian *dentatus* group, notably *C. bryani* Santschi and *manni* Wheeler, which I have discussed in a recent paper,<sup>1</sup> and certain species of the Neotropical subgenus *Myrmocladoecus* (genus *Camponotus*), especially *bidens* Mayr, *callistus* Emery, *corniculatus* Wheeler, etc., in which the thorax and petiole of the small workers are surprisingly like the corresponding parts of the worker *Froggattella* and quite unlike those of their cospecific females. These species of *Colobopsis* and *Myrmocladoecus*, however, possess forms (soldiers in *Colobopsis*, major and media workers in *Myrmocladoecus*) which bridge the gap between the smallest worker and the female caste. In *Froggattella* no such intermediates occur so that the contrast in structure between the worker and female is

<sup>1</sup> 'Some Aberrant Species of *Camponotus* (*Colobopsis*) from the Fiji Islands.' 1934, Ann. Ent. Soc. Amer., XXVII, pp. 415-424, 5 figs.



more startling. Though the genus is in all probability an ancient specialized offshoot of *Iridomyrmex*, which has monomorphic workers, we may perhaps assume that *Froggattella* originally possessed di- or polymorphic workers like *Colobopsis* and *Myrmocladoecus* and that the larger forms or soldiers have been lost completely during phylogeny. In this respect *Froggattella* would resemble such myrmicine genera as *Carebara*, *Erebomyrmex*, *Paedalgus* and most species of *Solenopsis*, which have also lost the major worker or soldier caste that still exists in *Solenopsis geminata* and in allied genera such as *Oligomyrmex*, *Aëromyrma*, etc. Since the extraordinarily similar thoracic and petiolar structure of the workers of *Froggattella* and of the smallest workers of certain species of *Colobopsis* and *Myrmocladoecus* represent quite independent lines of descent, we must assume that these ants exhibit an unusually interesting example of "convergence," or what German biologists have recently been calling "typovergence."

There are no data in the literature on the habits of *Froggattella kirbyi*, except Lowne's remark that he found it "under loose bark in spring and early summer." Colonies or portions of colonies may, perhaps, hibernate in such situations, but I am convinced that Lowne did not see the true nest. Although I made many myrmecological excursions in New South Wales in 1914 and 1931, I encountered *Froggattella* only on seven or eight occasions and always in the dry, open *Eucalyptus* bush. The workers were ascending and descending the trunks of small trees in straggling files and were evidently visiting coccids or psyllids on the foliage. On four occasions I succeeded in tracing the insects to their nests. Two of these, belonging to the subspecies *bispinosus* Forel, were observed near Southerland, N. S. W., on November 23 and December 1, 1914. Of the other two, which I refer to the typical *kirbyi*, one was found December 26, 1931, in the National Park, the other on the following day at Epping, N. S. W. All these nests were in small, dead, standing trees whose trunks measured only two and one-half to three inches in diameter. When broken open their wood was found to be tunneled throughout with narrow galleries occupied by a population of many hundreds of workers with quantities of brood in all stages. The National Park colony contained also dozens of mature males and winged females, the Epping colony a great number of males but few females. The workers were inoffensive like many of the smaller species of *Iridomyrmex* so frequently encountered in the Australian bush. Some of these (e. g., *nitidus* Emery) also regularly form very populous colonies in dead wood.

KEY FOR THE IDENTIFICATION OF THE *Froggattella* WORKERS

- 1.—Larger forms, averaging 2.3–3.7 mm.; head subcordate, decidedly broader and laterally more convex behind than in front; funicular joints all distinctly longer than broad; epinotal spines dorsoventrally flattened, compressed and subspatulate, bearing the spiracles on their expanded bases; meso- and epinotum sharply, longitudinally rugose. . . . . 2.  
 Smaller form, averaging 2.2–2.5 mm.; head much narrower and laterally less convex behind the eyes; funicular joints 3–10 as broad as long; epinotal spines thicker, shorter, subtriangular, bearing the spiracles near their tips; meso- and epinotum sharply and finely reticulate, with faint longitudinal rugules. South Australia. . . . . *latispina*, n. sp.
- 2.—Mesoepinotal impression rather shallow, the base of the epinotum in profile rising from it gradually and with feeble convexity. . . . . 3.  
 Mesoepinotal impression deeper and more pronounced, the base of the epinotum rising abruptly, with strong convexity. . . . . 5.
- 3.—Epinotal spines narrow and rather slender. Length, 3.5–3.7 mm. New South Wales. . . . . *kirbyi* Lowne (typical).  
 Epinotal spines distinctly broader. . . . . 4.
- 4.—Superior border of petiolar node thick and entire; legs brown; gaster subopaque, with violet metallic reflections. Length, 2.5–3.5 mm. Queensland. . . . . *ianthina*, n. subsp.  
 Superior border of petiolar node thinner, distinctly impressed in the middle; femora and tibiae black; gaster shining, with faint greenish reflections; head and thorax more distinctly microscopically reticulate. Length, 2.5–3.5 mm. Queensland. . . . . *nigripes*, n. subsp.
- 5.—Antennal scapes nearly or quite reaching the posterior border of the head; head, thorax and petiole red. Length, 2.5–3.3 mm. New South Wales. . . . . subsp. *bispinosa* Forel.  
 Antennal scapes shorter; head, thorax and petiole paler. . . . . 6.
- 6.—Smaller and more slender (2.3–2.8 mm.); posterior border of head nearly straight; superior border of petiolar node broadly rounded; head, thorax, petiole and legs brownish yellow; gaster brown. New South Wales. . . . . *lutescens*, n. subsp.  
 Larger and more robust (3–3.5 mm.); head broader and laterally more convex behind, its posterior border distinctly concave; antennal scapes shorter; epinotal spines broader; superior border of petiolar node broader, distinctly impressed in the middle; head, thorax and petiole yellowish red; femora and tibiae yellowish brown; gaster very dark brown. South Australia. . . . . *laticeps*, n. subsp.

*Froggattella kirbyi* (Lowne)

*Acantholepis kirbyi* LOWNE, 1865, The Entomologist, II, p. 333, ♀.

*Hypoclinea kirbyi* MAYR, 1870, Verh. Zool. bot. Ges. Wien, XX, p. 956, ♀.

*Dolichoderus kirbyi* DALLA TORRE, 1893, 'Cat. Hymen.', VII, p. 159, ♀.

*Froggattella kirbyi* FOREL, 1902, Rev. Suisse Zool., X, p. 459, ♀; EMERY, 1912, 'Genera Insect.', p. 21, ♀.

WORKER.—Length, 3.5–3.7 mm.

Head distinctly longer than broad, decidedly broader behind than in front,

with rather straight, anteriorly converging cheeks, the sides behind the eyes convex, the posterior corners broadly rounded, the posterior border broadly and feebly excised. Eyes elliptical, situated about one and one fourth their length from the posterior clypeal suture. Mandibles convex, with rounded external border, the masticatory border with 7-8 teeth, the two apical teeth large, the others subequal, broad and directed very slightly backward. Clypeus feebly and evenly convex, its anterior border straight and transverse in the middle, sinuate on each side. Frontal area large, triangular, not impressed, indistinctly defined. Antennal scapes narrow and distinctly flattened at the base, widening apically, not reaching the posterior border of the head by a distance equal to the greatest diameter of their tips; first funicular joint twice as long as broad; joints 7-10 as broad as long, terminal joint not longer than the two preceding joints together. Pronotum without the neck as broad as long, convex above and laterally; mesonotum less than half as broad as the pronotum, rectangular, about one-third longer than broad, its dorsal outline in profile straight and sloping to the mesoepinotal impression with the dorsally projecting metanotal spiracles just behind its middle third. Epinotum about as long as the mesonotum, widened behind ventrally, its base in profile rising in a gradual even curve from the mesoepinotal impression and becoming straight and horizontal where it is continued into the spines. Seen from above the bases of the spines are angularly widened, their blunt, flattened, distal portions rather narrow and subparallel, more than twice as long as broad, slightly deflected at their tips. Declivity of epinotum shorter than the base, semicircularly concave in profile. Petiole from above fully twice as long as broad, broader in front than behind, with posteriorly slightly concave sides, the inclined scale with straight, transverse summit and rectangular corners. In profile the petiole is fully twice as long as high, the scale very blunt, projecting beyond the anterior border of the segment. Legs long and stout, the femora, especially the fore pair, distinctly thickened in the middle.

Smooth and shining, with fine, sparse, piligerous punctures; antennal scapes more densely punctulate; neck sharply, base of epinotum more superficially reticulate; mesonotum, gaster and legs microscopically and superficially shagreened; mesonotum, mesoepinotal impression and sides of epinotum regularly, sharply and longitudinally rugose, with the interrugal spaces finely and rather superficially reticulate. The rugae, which are somewhat less numerous in the mid-dorsal region of the mesonotum, pass without interruption across the impression which represents the mesoepinotal suture.

Hairs and pubescence white or pale yellowish, the former generally distributed, erect, sparse, delicate, of uneven length, longer on the body than on the appendages; pubescence fine, appressed, moderately dense, distinct only on the clypeus, funiculi, coxae and tibiae.

Bright red or yellowish red; gaster black, with blue reflections; legs, including the coxae and sometimes the petiole, brown; tarsi yellowish; teeth of mandibles, tips of antennae and last joint of tarsi blackish.

FEMALE.—Length, 7-8.5 mm.; fore wings 7.5 mm.

Head resembling that of the worker, but proportionally larger, broader anteriorly, with broader and more deeply concave posterior border, sharper posterior corners, larger and more convex eyes. Frontal area more distinct, but not impressed. Antennal scapes proportionally shorter, their tips reaching only to the lateral ocelli or

slightly beyond. Pronotum narrowed toward the neck, much narrower than the mesonotum, which is longer than broad, produced and narrowly rounded anteriorly, scutellum as long as broad, epinotum subtrapezoidal from above, as long as broad, narrowed posteriorly, its base in profile moderately convex, somewhat sloping, passing rather abruptly into the declivity, which is distinctly concave and not more than a third as long as the base. The epinotal spines of the worker are represented by a very small, low welt on each side at the posterior end of the base. Petiole from above only about one-fourth longer than broad, as broad behind as in front, with concave sides and with the scale of the worker replaced by a transversely elliptical node, twice as broad as long, flattened above, with nearly perpendicular anterior and sloping posterior surface and the posterior peduncle much shorter than the node. Gaster long, with subparallel sides, the first segment narrowed anteriorly, with concave, marginate median border and sharply marginate anterior corners; in profile with the base deeply concave at its junction with the postpetiole.

Subopaque, or lustrous; legs and petiole more shining; head and thorax punctate-rugulose, the rugules delicate, longitudinal on the clypeus, front and mesonotum transverse on the occiput, pronotum and base of epinotum, where they are arcuate and coarser. Mandibles finely reticulate and coarsely and sparsely punctate. Petiole, gaster, scapes and legs finely reticulate-punctate.

Hairs as in the worker but the appressed pubescence much more abundant, longer and investing all parts of the body except the petiole, though nowhere concealing the integument except on the gaster where it becomes very dense and snow white at the posterior border of each segment, thus forming a rather broad, sharply defined, band. The pubescence of each band converges sharply at the mid-dorsal line but turns laterally on each side, becoming transverse on the sides of the gaster.

Head, thorax and petiole dull yellowish red; gula, epinotum and petiole somewhat paler; sides of clypeus, front and vertex blackish brown as are also the scutellum, a large spot on the posterior portion of the mesonotum, continued forward as a narrow median vitta and two broader parapsidal vittae and a large elliptical spot on each side, covering the posterior portion of the pronotum and the mesopleurae. Legs dark brown, with the coxae and extensor surfaces of the femora and tibiae black; gaster deep black except for the sharply contrasting fasciae of dense white pubescence. Wings colorless, with pale brown veins and dark brown pterostigma.

MALE.—Length, 3–3.5 mm.

Head small, about one-fourth broader than long through the eyes, flattened; ocelli transversely elliptical, the anterior one surrounded in front by a deep semi-circular groove, the posterior directed laterally and connected by a straight, thick, transverse welt. Clypeus with a circular median convexity, its anterior border rounded and somewhat projecting in the middle, sinuate on each side, frontal area convex, triangular, slightly longer than broad. Antennal scapes only one and one-half times as long as broad; first funicular joint slightly shorter than the second, which like all the joints except the last is nearly as broad as long. Thorax much broader than the head, the large mesonotum as broad as long; scutellum as long as broad, shaped like the mesonotum but reversed; epinotum evenly rounded and sloping in profile, without distinct base and declivity. Petiole nearly twice as broad as long, wider behind than in front, in profile higher than long, the node broadly rounded and medially impressed above; postpetiole broadly articulated to the gaster so that the

anterior slope of the node is long and steep, the posterior slope very short and rounded. Stipites of genitalia very small, subtriangular, their tips rounded, their bases very largely membranous; volsellae long, slender, falcate, with acute tips; sagittae broad, subelliptical, with finely serrate ventral borders.

Shining, finely reticulate or shagreened, with fine scattered, piligerous punctures.

Pilosity as in the worker but shorter and sparser; appressed pubescence generally distributed, as in the female, but shorter and much more dilute, not dimming the shining integument, absent on the petiole.

Black; mandibles, mouth parts, tibiae, tarsi, petiole and genitalia piceous; first funicular joint and articulations, veins and pterostigma of wings paler and more yellowish brown.

The type locality, as recorded by Lowne, is Sydney. I have three topotypes collected by Mr. W. W. Froggatt and have seen many specimens from the following localities in New South Wales: National Park ♀ ♀ ♂, Hornsby ♀, and Southerland ♀ (Wheeler); Epping ♀ ♀ ♂ (Wheeler, F. R. Taylor); La Perouse ♀ (W. M. Mann); Asquith ♀ (H. P. Schrader).

I believe that I am correct in my identification of this, the typical form of the species. Unfortunately Lowne's and Mayr's descriptions are deplorably inadequate. Forel, who examined Lowne's type in Mayr's collection at Vienna says only that it differs from his own var. *bispinosa* in having the head narrower behind and not or scarcely excised and in having the base of the epinotum rising less abruptly from the mesoëpinotal impression.

#### *Froggatella kirbyi nigripes*, new subspecies

WORKER.—Length, 2.8–3.3 mm.

Very similar to the typical *kirbyi*, but differing in the following characters: epinotum shorter, the bases of its spines less angularly set off from their terminal portion, which is shorter, broader and more incurved. Petiolar node somewhat less inclined forward, its summit in profile thinner and more pointed, seen from behind transverse and distinctly impressed in the middle.

Microscopic reticulation of head and thorax distinctly coarser and more pronounced, especially between the longitudinal rugae of the meso- and epinotum. These latter regions and the petiole are also darker and more brownish than the head and pronotum. Tips of scapes, last joint of funiculi, lower portions of pleurae and coxae and in some specimens also the vertex of the head dark brown or fuscous; femora and tibiae black; gaster black with greenish reflections.

Thirteen specimens taken by Dr. P. J. Darlington during May, 1932, at Coen, on the Cape York Peninsula, Queensland.

#### *Froggatella kirbyi ianthina*, new subspecies

WORKER.—Length, 2.5–3.5 mm.

Closely resembling the two preceding forms and like them with shallow meso-

epinotal impression, without anteriorly abrupt base of the epinotum, but the head is distinctly narrower and less convex laterally, the antennal scapes somewhat shorter, the epinotal spines broader and shorter than in *nigripes* with their bases more expanded and more angulate laterally. Color and sculpture of head and thorax as in the typical *kirbyi*, but with the rugae of the meso- and epinotum less uniform. Legs paler brown than in the typical *kirbyi*. Gaster subopaque, densely and sharply shagreened, with pronounced metallic violet reflections.

Two specimens which I took November 10 and 12, 1914, near Brisbane, Queensland. The one taken on the latter date is the larger and may be regarded as the type, the other has the gaster more shining and seems to be transitional to the typical *kirbyi*. The true status of this subspecies cannot be determined without additional material.

*Froggattella kirbyi*, subspecies *bispinosa* Forel

*Froggattella kirbyi* var. *bispinosa* FOREL, 1902, Rev. Suisse Zool., X, p. 460, ♀; EMERY, 1912, 'Genera Insect.', p. 21, ♀.

WORKER.—Length, 2.5–3.3 mm.

This form differs from the typical *kirbyi* and the preceding subspecies in its distinctly smaller average size, in having the head somewhat broader and laterally more convex behind, the occipital border more concave, the antennal scapes nearly or quite reaching the posterior border and the mesoepinotal impression distinctly deeper, with the base of the epinotum rising anteriorly with a more abrupt curve and forming a more distinct angle with the horizontal posterior portion. The superior border of the petiolar node seen from behind is feebly convex, with more rounded lateral corners. The epinotal spines are like those of the typical *kirbyi* as are also the color, pilosity and sculpture.

Forel records this form from Sydney and Oatley, New South Wales (W. W. Froggatt). I assign to it a large number of workers which I collected November 23 and 26 and December 2, 1914, at Southerland, near Sydney.

*Froggattella kirbyi lutescens*, new subspecies

WORKER.—Length, 2.3–2.8 mm.

Structurally very similar to the subsp. *bispinosa* but averaging smaller; scapes not reaching to the posterior border of the head which is nearly straight. Microscopic reticulate sculpture even feebler and more superficial so that the head and pronotum are smoother and more shining, the interrugal reticulation of the meso- and epinotum less distinct. Color of head, thorax and petiole paler and more brownish yellow, head slightly darker; mandibles, clypeus and antennae yellow; legs brownish yellow, concolorous with the thorax and petiole; gaster dark brown, the first segment paler brown or in some specimens even yellowish at the base.

Seven workers taken by Mr. W. W. Froggatt near Sydney, New South Wales, and received from Mr. John Clark. These specimens were labelled "var. *bispinosa* Forel, cotypes." It is quite possible that Forel based his variety on specimens of what I regard as two different forms.

His description, however, is certainly more applicable to the form for which I have retained his name.

*Froggattella kirbyi* laticeps, new subspecies

WORKER.—Length, 3–3.5 mm.

More robust than the typical *bispinosa*, head proportionally larger and broader behind, with sharper, less rounded posterior corners and more deeply excised posterior border. Antennal scapes decidedly shorter, not attaining the posterior border of the head by at least one and one-half times their greatest diameter. Pronotum, excluding neck, broader than long; mesonotum only one and one-fourth times as long as broad; mesoepinotal impression as in *bispinosa*, but the epinotum is longer, its spines broader. Superior border of petiole seen from behind distinctly impressed in the middle, with more angular corners than in *bispinosa*. Sculpture and pilosity as in that subspecies except that the rugae on the dorsal surface of the mesonotum are finer and the gaster is more sharply shagreened. Head, thorax and petiole of a distinctly paler, more yellowish red or reddish yellow, the femora and tibiae yellowish brown, the gaster very dark brown instead of black.

Described from numerous specimens collected by Mr. B. A. Feuerherdt at Lucindale, South Australia.

*Froggattella latispina*, new species

WORKER.—Length, 2.2–2.5 mm.

Smaller than any of the subspecies of *kirbyi* and differing in the shape of the head and epinotal spines, in sculpture, etc. Head longer in proportion to its width, narrowed posteriorly so that the sides behind the eyes are less convex and more nearly parallel, the posterior border nearly straight; antennal scapes very short, not reaching the posterior border of the head by fully twice their greatest diameter; funicular joints 3–10 distinctly shorter than in the various forms of *kirbyi*, not longer than broad. Eyes slightly more convex. Pronotum less convex, broader than long without the neck; promesonotal suture more deeply impressed; mesonotum shorter, scarcely one and one-fourth times as long as broad; metanotal spiracles less projecting dorsally; mesoepinotal impression somewhat deeper and more abrupt than in the subsp. *bispinosa*; epinotum somewhat longer than broad, the base convex, rising abruptly from the mesoepinotal impression and terminating behind in two very broad, thick spines only slightly longer than the width of their bases from which they taper rapidly to very blunt tips. They are not curved inward and their mesial borders when seen from above form a perfect semicircle with the median posterior border of the base included between them. The epinotal spiracles are borne on the sides of the spines near their tips. Epinotal declivity much shorter and much more deeply concave in profile than in any of the forms of *kirbyi*. Petiole distinctly shorter but the node shaped as in the subsp. *bispinosa* with its superior border feebly convex when seen from behind.

Microscopic reticulation of the body and appendages much more pronounced than in any of the other forms of *kirbyi*, especially on the head, meso- and epinotum. On the front the reticulation becomes longitudinal so that the surface has a finely granulated-striolate appearance. On the meso- and epinotum it is even coarser and

the sharp longitudinal rugae of *kirbyi* are reduced to fine granular rugules except on the mesoepinotal impression which is traversed by the usual sharp rugae or costae. Pronotum, epinotal declivity and petiolar node much smoother and more shining than the head; costae on the posterior peduncle of the petiole well developed.

Erect hairs white and distributed much as in *kirbyi* and its subspecies but distinctly shorter on the body and decidedly less numerous on the legs.

Head yellowish red; coxae, thorax and petiole slightly paler; mandibles and antennae yellow; last joint of funiculi fuscous; femora and tibiae brown; gaster brown-black.

Described from 10 workers collected by Mr. A. M. Lea at Port Lincoln, South Australia.





# AMERICAN MUSEUM NOVITATES

Number 843

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

April 29, 1936

## AFRICAN AND AMERICAN OLIGOCHAETA IN THE AMERICAN MUSEUM OF NATURAL HISTORY

By W. MICHAELSEN<sup>1</sup>

The Oligochaeta kindly intrusted to me for examination by The American Museum of Natural History of New York include some very interesting forms, mostly from Central Africa. From one point of view, the material disappointed me. I had hoped to find among the Oligochaeta of the American Museum some new endemic species from the West Indies, which would fulfill my long-felt desire to advance our scanty knowledge of this rapidly disappearing fauna. There was, in fact, in the collection an endemic oligochaete from Haiti, but of an already known species. I take this opportunity to urge the importance of a prompt examination of the oligochaete fauna of the West Indies.

I wish to express my heartiest thanks to Dr. W. G. Van Name, as well as to Dr. G. E. Gates, through whom my wish to examine these specimens was made known to the authorities of the American Museum.

The following are the species especially dealt with in this paper, six of them being new.

<i>Andiorrhinus duidanus</i> , new species	Venezuela
<i>Alma basongonis</i> Michaelsen	Belgian Congo
<i>Dichogaster chapini</i> , new species	Belgian Congo
<i>Dichogaster navana</i> , new species	Belgian Congo
<i>Dichogaster godeffroyi</i> Michaelsen	Haiti
<i>Dichogaster ioliensis</i> Michaelsen	
forma <i>typica</i> Michaelsen	Belgian Congo
forma <i>moorei</i> (Beddard)	Belgian Congo
<i>Stuhlmannia congica</i> , new species	Belgian Congo
<i>Eminoscolex navanus</i> , new species	Belgian Congo
<i>Eminoscolex langi</i> , new species	Belgian Congo

Another new specific name is also established: *Stuhlmannia mayiliensis*, for *Platydrilus inermis* Michaelsen, 1910, on account of pre-occupation.

***Andiorrhinus duidanus*, new species**

Figure 2

LOCALITY.—Southern Venezuela, Cerro Duida, north of the upper Orinoco, about 68° west long., 3° 12' north lat., at the summit, 5500 ft., "Provisional Camp"; Tyler Duida Expedition.

<sup>1</sup> Hamburg.

**MATERIAL AVAILABLE.**—A sexually mature, complete specimen, and a half-mature, incomplete one. Type, Cat. No. 2249, American Museum of Natural History.

**DESCRIPTION.**—Dimensions of the complete specimen: length about 100 mm., thickness 3 to 5 mm., width at the clitellum 6 mm., number of segments about 146.

Color brown, dorsally very dark, ventrally a little lighter.

Head prolobous. Prostomium high, dome-shaped, somewhat longer than thick. A very short basal part of it is pulled into the buccal cavity (early state of the formation of a proboscis?).

Setae beginning both ventrally and dorsally at the third segment, paired; in general *aa* is smaller than *bc*, *dd* about equal to half the circumference of the body. Behind the middle of the body *aa:ab:bc:cd:dd* is approximately 3:1:5:1:17. The setae are slightly S-shaped, the simple, acute, extreme ectal end is bent to a small hook, which forms an angle of about 80° with the middle part of the seta. Somewhat beneath this hook the seta is sparingly ornamented by some broad, shallow depressions with sharp ental borders and slightly concave ectally. The setae are in general rather large, about 1 mm. long, and in the middle about 55 $\mu$ , at the ental end about 70 $\mu$  thick. Those of the fore end are somewhat smaller, but not properly called slender, as they are in other species of this genus; a seta from segment VI being 0.6 mm. long, and 36 $\mu$  thick.

Clitellum on segments XVI to XXIV (= 9); on segment XVI and XXIV less developed, on the other segments very prominent and distinctly broadened. It is saddle-shaped, interrupted in the median ventral part. The sharp borders of the middle part of the clitellum lie just lateral to the lines of the setae *b* and are bent off laterally at the fore and the hinder ends of the clitellum.

Longitudinal walls of puberty are not distinctly developed, but there seemed to be a somewhat lighter longitudinal stripe at each border of the clitellum, extending over the five segments from XIX to XXIII.

Male and female pores not distinguishable.

Spermathecal pores indistinct; three pairs situated at the intersegmental furrows VI/VII, VII/VIII and VIII/IX, and median to the lines of setae *a*. The ventral part of segments IX and VIII, and to a less extent that of segment VII, is somewhat thickened and glandular.

Clitellar sexual setae about 2 mm. long, in the ectal half nearly straight, in the ental half slightly bent; 40 $\mu$  thick in the middle portion, and about 60 $\mu$  thick at the ental end; the thickness diminishing only a little to about 35 $\mu$ , toward the ectal end. The extreme ectal end is again a little thickened and finally ends in an acute, beak-shaped point. The ectal half of the sexual seta with the exception of the beak-shaped extreme end is ornamented by four longitudinal rows of rather deep scars which are bordered entally by a sharp, ectally concave, nearly semicircular rim, while they slightly flatten toward the ectal end. The scars of adjacent rows alternate, but not quite regularly. The scars of one row, about 30, are rather closely arranged. The segments of the seta marked by two successive scars are shorter than the thickness of the seta.

The spermathecal sexual setae: The ventral setae of segments VII and VIII correspond in form and ornamentation to the clitellar ones, but are somewhat smaller, those of the VIII segment being only 1.5 mm. long. These spermathecal sexual setae correspond to the normal setae *a* and *b* but are displaced medially, and those of each pair are closely approximated.

The septa, present from intersegmental furrow VI/VII, are all very slightly developed. No thickened septum in the region anterior to the gizzard was recognizable.

Intestinal canal: A large, nearly globular gizzard in segment VI, three pairs of irregularly pear-shaped chylous pouches in segments VII, VIII, and IX. They are lamellar pouches, each with about 30 lamellae, which are not everywhere quite regularly formed. I could not recognize any appendages at the pouches. The intestine bears a broad ribbon-shaped typhlosole. A transverse section of it has a narrow, only slightly bent contour, not broadened either at the basal or at the distal end.

Nephridia with a minute, somewhat elongate muscular sphincter completely embedded in the body wall.

Male organs: Two pairs of testis sacs ventrally placed in segments X and XI, those of one segment apparently communicating in the median line, each containing a large funnel in its median hinder part. The testis sacs are continued in large testis-sac appendages, those of one pair embracing the intestine, joining on its dorsal aspect, but apparently without communicating with each other there. From the testis sacs of the hinder pair some small, dome-shaped or nearly globular appendages extend out, probably entering segment XII, and representing seminal vesicles.

Spermathecal organs (Fig. 2): The spermathecae of the anterior pair are distinctly smaller, those of the posterior pair larger than those of the middle pair. Ampulla elongate sac-shaped or bulb-shaped, always rather shriveled. Duct cylindrical, irregularly bent, thinner and shorter than the ampulla, from which it is generally not sharply set off. The ectal part of the duct is somewhat flattened and opens out in a simple manner, through the slitlike spermathecal pore. The structure of the spermatheca is peculiar. The ampulla is thin and smooth-walled, with slightly developed muscles. The wall of the duct is a little thicker, externally smooth, with a moderately thick, irregular layer of muscles. Internally it is uneven, as the cylindrical cells of its epithelium are of different lengths and prominent to different degrees. These cells do not seem to form a close layer, and in the small gaps between them are affixed numerous spermatozoa by their head ends, which are stained dark purple by haematoxylin-eosin. The tails of these, which are feebly stained light red, project into the lumen of the duct entirely toward the ampulla, partly even entering the basal part of the latter. There are no typical seminal chambers in the wall of the duct, but all spermathecae examined in a series of slides showed, in three cases distinctly, a peculiar structure, which I must consider as the homologue of a seminal chamber (*sr*). Somewhat entirely from the ectal end of the duct there is a lentiform cavity in its fore-side, communicating by a broad opening with the lumen of the duct, and formed only by a decrease in the thickness of the wall. On the outer surface of the duct there is no indication of this cavity, the surface being quite even. The inner surface of this cavity is densely crowded with spermatozoa, just like the other parts of the duct, perhaps somewhat more densely and more regularly than the latter. Medially from each spermatheca there lies a sac-like organ (*ag*) much smaller than the neighboring spermatheca, to whose duct the narrower ectal part of this sac-like organ is closely attached. These organs have a moderately thick wall with apparently irregularly arranged muscles, and a moderately thick, irregular epithelium, the cells of which seem to be glandular. The lumen is rather wide, partially filled by granular and fibrous material, doubtless a secretion of the epithelium. In this material remnants of the epithelial cells are still to be seen. I could not see distinctly the opening of these sac-like organs, but I believe I saw some narrow fissures in the wall of the organ,

leading outward through the glandular body wall in the vicinity of the spermathecal pores. These are doubtless homologues of certain organs of *A. amazonias* Michaelsen (1917, p. 211) and of *A. rubescens* Michaelsen (1925, p. 288) which I regarded as evertable copulatory pouches. In this new species they do not appear to be evertable. I therefore consider it better to call them accessory glandular pouches. Finally, in segments VII and VIII the sacs of the spermathecal sexual setae with their accessory glands are located, attached to the spermathecal apparatus. These organs lie in the two gaps between the three spermathecas. These sexual setae of segments VII and VIII, corresponding to the normal setae *a* and *b*, have each a separate setal sac, but the two sacs of each pair are closely approximated and are joined by a short muscle bundle at their ental ends. The glands joined to these sexual setae project medially from them far into the coelom. Those of the segment VII are moderately large and simple, although externally uneven or even lobed, those of the segment VIII are larger and two-lobed, cleft nearly to their bases.

REMARKS.—*A. duidanus* is nearly allied to *A. amazonias* Michaelsen (1917, p. 206, Pl. II, fig. 22; 1921, p. 23) and to *A. rubescens* Michaelsen (1925, p. 285), both of which come from the Amazon region. With these, it has in common the possession of accessory glandular pouches on the spermathecas; with *A. amazonias*, moreover, it agrees in the shape of the normal setae. The new species is distinguished from those species by the shape of the spermathecas and the peculiar manner of storing the spermatozoa in them, as well as by the characteristic ornamentation of the sexual setae. In the dimensions of the normal setae no one of the older known species equals this new one. Only *A. pictus* Michaelsen (1925, p. 280) comes near to it, its normal setae being as long as 0.8 mm.

#### *Alma basongonis* Michaelsen

*Alma basongonis* MICHAELSEN, 1936.

LOCALITY.—Belgian Congo, Stanleyville, middle Congo, 0° 30' north lat., 25° 10' east long., Lang-Chapin Congo Expedition, February, 1915.

FURTHER DISTRIBUTION.—Belgian Congo, Basongo, 4° 30' south lat., 20° 15' east long.

MATERIAL AVAILABLE.—Many specimens found in company with another, larger species of *Alma*, which is represented only by immature specimens not sufficient for determination.

#### *Dichogaster chapini*, new species

Figures 5, 9

LOCALITY.—Belgian Congo, Medje at the river Nava, northern affluent of the Aruwimi; 2° 25' north lat., 27° 20' east long.; Lang-Chapin Congo Expedition.

MATERIAL AVAILABLE.—Four mature specimens and some immature ones. Type, Cat. No. 2250, American Museum of Natural History.

DESCRIPTION.—Dimensions of the mature specimens: length 50–60 mm., thickness 2.5 to 3.5 mm., number of segments 80–210.

Color brown.

Body cylindrical, head epilobous, prostomium very small, its dorsal appendage triangular, the hinder angle just reaching the annulation-furrow of segment I. Segments anterior to the clitellum indistinctly annulated, 2- or 3-ringed.

Setae rather slender, strictly paired; in general *aa* a little larger than *bc* (less in the clitellar region?), *dd* distinctly greater than half the circumference of the body. At the middle part of the body *aa:ab:bc:cd:dd* approximately equals 13:1:11:1:96; *dd* = seventeen-twelfths of *u*.

First dorsal pore at the intersegmental furrow VIII/IX if not at VII/VIII.

Clitellum indistinctly limited, including segments XIII to XXII or XXIII (= 10 or 11), but at segment XXII only feebly developed, and at XXIII, at the most very feebly and only dorsally. The clitellum is ring-shaped at segments XIII and XIV; further behind it is more feebly developed, if not interrupted for a short distance on the median ventral aspect.

Male field forming a small four-sided depression extending median-ventrally between the middle zones of the segments XVII and XIX. Laterally it extends nearly to the rows of setae *a*. The four corners of this depression reach to the centers of two pairs of moderately large whitish circular gland areas or more or less prominent glandular cushions, situated in the lines of setae *ab* in the middle zone of segments XVII and XIX; these are the prostate porophores. The prostate pores lie in the centers of these porophores, and those of one side are connected with one another by sharply impressed seminal furrows. The seminal furrows are curved toward the median line at the ends, but laterally curved in the middle parts. There are no accessory longitudinal walls of a glandular nature. The male pores are situated at the top of minute papillae in the bottom of the seminal furrow, somewhat in front of the middle of them, and just behind the intersegmental furrow XVII/XVIII, nearer to the fore pair of prostate pores than to the hinder pair.

Spermathecal pores quite indistinct; there are two pairs situated at the intersegmental furrows VII/VIII and VIII/IX in the rows of setae *a*.

Septa V/VI and VI/VII very thin, VII/VIII a little thickened in the middle part, VIII/IX moderately strong, IX/X and XI/XII rather strong, XII/XIII and XIV/XV by degrees thinner, the succeeding ones thin.

Alimentary canal: Two rather large gizzards in segments V and VI, and three pairs of nearly equally large chylous pouches, lamellar pouches, lateral to the oesophagus in segments XV to XVII. They are widely kidney-shaped with some indentations on the convex margin. Intestine with a simple, irregularly meandering typhlosole, narrowly triangular in cross section, with a sharp edge.

Excretory organs: There are four rather regular longitudinal rows of meronephridia, at least in the middle part of the body, on each side. Those of the three upper rows are rather large, simple, flattened sac-shaped; those of the lowest row are not simple, but apparently divided into a few smaller meronephridia, which are not sac-shaped. Perhaps these are connected with one another. The number of meronephridia in half a segment must therefore be regarded as four, if not as a few more, according as those of the lowest row are taken as one or as several.

Anterior male organs holoandrous. Two pairs of small tufted testicles project backward from the ventral margin of septa IX/X and X/XI. Opposite them, at the ventral part of the septa X/XI and XI/XII, lie two pairs of high-rimmed, cup-shaped male funnels. Spermatogems fill laterally and dorsally nearly the whole

coelom of segments X and XI, forming thick masses, especially in the dorsal parts. I could recognize no membrane enveloping the testicles, the male funnels and the spermatogems, i. e., no testis sacs. All these organs seem to lie free in the coelom. One pair of grape-like seminal vesicles project from septum XI/XII into the twelfth segment.

Posterior male organs: Two pairs of nearly equally large prostates in segments XVII and XIX. The glandular part is whitish, tubular, about 0.16 mm. thick, very long, irregularly coiled, with a very narrow axial channel. Duct sharply set off from the glandular part, very much shorter, though relatively rather long, tubular, about 0.05–0.06 mm. thick, muscularly lustrous. Each prostate is accompanied by a penial-seta sac, containing a single penial seta. Penial setae slender, switch-shaped, about 1.5 mm. long, in the ectal half very thin ( $7-9\mu$ ), in the ental half, especially at the inner end thicker (as much as  $25\mu$ ). Ental half simple, moderately bent, ectal half, with exception of the extreme end (about the sixth part of the whole seta) nearly straight; the extreme ectal end slightly bent, nearly sickle-shaped, simply pointed and rather acute. With exception of the sickle-shaped end and a short adjacent part, the ectal half shows a slight, rather regular serpentine undulation, the amplitude of which nearly equals the width of the seta. I counted about eight or nine undulations, which become less distinct at the end of this serpentine part and which are distinctly visible only in a certain position of the seta, and are more or less indistinct if this position is altered. The thin fibrous axis of the setae shows this serpentine undulation in a lesser degree, but is not quite straight. Even with strong magnification I could not recognize any external ornamentation, spines, scales or scars, on the penial seta. The surface seemed to be quite smooth. The ectal ends of the male ducts are not thickened, the extreme ends piercing through the body wall even get thinner.

Female organs: A pair of very large pear-shaped ovaries project from the ventral border of septum XII/XIII into the thirteenth segment. The apparently mature egg-cells of the ovaries are exceedingly large, about 0.1 mm. in diameter. The female funnels, lying opposite to the ovaries, are conical cups. The oviducts are moderately long, quite straight, very narrowly conical, rather thick at the ental end, getting thinner toward the ectal end.

Spermathecae (Fig. 9) all nearly equally large. Ampulla rather small, sac-like or pear-shaped, set off from the middle part of the spermatheca by a neck-like constriction. The middle part is about as thick as the ampulla, somewhat shorter than the slender muscular duct, from which it is set off more or less sharply. In five of the seven spermathecae which I could examine, there lay, besides the ental end of the ectal muscular duct, two small pear-shaped diverticula close together and hanging down ectally, discharging through a short, narrow common stalk into the ectal end of the middle part of the spermatheca. Each diverticulum contains a nearly globular ball of sperm. In two of the seven examined spermathecae there was only a single pear-shaped diverticulum. All spermathecae were more or less crooked or curved.

### *Dichogaster navana*, new species

Figures 3, 8

LOCALITY.—Belgian Congo, Medje at the river Nava, northern affluent of the Aruwimi,  $2^{\circ} 25'$  north lat.,  $27^{\circ} 20'$  east long., Lang-Chapin Congo Expedition.

MATERIAL AVAILABLE.—A single, rather softened specimen. Type, Cat. No. 2251, American Museum of Natural History.

DESCRIPTION.—Dimensions: Length 80 mm., thickness 3–3.5 mm.; number of segments about 10.

Color light brown, dorsally hardly darker than ventrally, a little iridescent.

Head? (prostomium drawn in). Segments rather regularly three-ringed, some anteriorly adjoining the clitellar region divided by narrow secondary ring-furrows into four or five annules.

Setae very slender, strictly paired, all situated ventrally;  $aa = bc$ ,  $dd = \frac{1}{4}u$  (approximately).

Clitellum ring-shaped, at segments XIII to XIX (= 7); at segment XIII very poorly developed.

Male field restricted to the two anterior thirds of segment XVIII. It is a transverse depression with a spindle-shaped contour, with a higher anterior border, which exhibits two deep incisions.

Prostate pores one pair, situated in the lateral parts of the male field (in the lines of setae  $a$ ?), in or near the middle zone of the segment XVIII. Male pores not recognized.

Spermathecal pores inconspicuous, one pair situated ventrally at the intersegmental furrow VII/VIII.

Septa VI/VII to X/XI very thin, XI/XII and XIII/XIV distinctly thickened, but still to be called only moderately thick, the succeeding ones thin.

Alimentary canal: Two rather large barrel-shaped gizzards anterior to the sexual region (in the fifth and sixth segment?). Three pairs of broadly kidney-shaped chylous pouches, which are lamellar pouches, with some rather deep incisions in the convex border, in segments XV, XVI and XVII, those of the middle pair larger than the anterior, but smaller than the posterior ones. The latter discharge independently, those of the two anterior pairs seem to discharge by a common duct into the oesophagus (not distinctly seen!). Intestine with a broad lamellar typhlosole which is simple, at least in the middle part of the body.

Excretory organs (nearly macerated): Apparently six or seven sac-like meronephridia in each side of a segment.

Anterior male organs holoandrous. Two pairs of plate-like testis sacs, ventrally situated in the tenth and eleventh segments, the whole ventral part of which they occupy. Those of one side touch one another and are separated only by a thin septum; those of one segment are joined together in the median ventral line, indicating that each pair originates by a median ventral longitudinal furrow. Two pairs of wide male funnels, those of the tenth segment in the hinder parts, those of the eleventh segment in the middle part of the respective testis sac. A pair of wide sac-like seminal vesicles depend from septum XI/XII into the twelfth segment. I could not recognize seminal vesicles in the eleventh segment. The seminal vesicles as well as the testis sacs contain many nearly globular parasites (sporocysts).

Posterior male organs: One pair of prostates in the eighteenth? segment. The glandular part is whitish, very long, thinly tubular, and densely coiled. Duct sharply set off, very much thinner and shorter, though of moderate length, with a feeble muscular luster. Each prostate opens together with a penial setal sac, which contains apparently only one penial seta. Penial seta (Fig. 3) about 2 mm. long; at the ental end about  $60\mu$  thick, in the middle, about  $35\mu$  thick; toward the ectal end the thickness diminishes to  $15\mu$  a little before the tip. The seta is very slightly bent in the ental half, irregularly bent in the ectal half; the ectal quarter being bent in an



obtusely rounded angle. The ectal tip is simple, somewhat bent into a hook. The penial seta has a characteristic ornamentation. In the ectal sixth part of the seta this consists of widely scattered, triangular, ectally inclining fine spines. Entally the spines become somewhat more dense and somewhat slenderer; the lateral borders of the spines are continued into the interior of the seta by structural lines nearly reaching the axis of the seta. An optical longitudinal section through the seta shows in consequence a rather dense hatching of entally converging lines.

Spermatheca (Fig. 8): Ampulla small, widely pear-shaped, set off from the middle part of the spermatheca by an insignificant neck-like constriction. Middle part expanding ectally, finally becoming somewhat thicker than the ampulla, about twice as long as the latter. Externally it is not sharply set off from the muscular duct, which is distinguished from it only by its muscular luster. The wall of the middle part is rather thin, but its wide lumen is narrowed in places by some longitudinal membranes projecting from the inner side of the wall. Muscular duct about as long as the ampulla and middle part together, and becoming thinner only at the ectal end. Its wall is thick, muscular, its axial lumen very narrow and simple. At the ental end of the muscular duct, and projecting a little over the middle part also, a blunt, nearly globular diverticulum, which is nearly as thick as the muscular duct and its middle part depends from the spermatheca. The diverticulum is joined to the spermatheca by a rather broad base, and inclines somewhat entally. It contains a large, but not simple sperm chamber. The ental pole of this sperm chamber is divided by a deep cleft into two equally large parts, which join together ectally and are continued by a narrow channel. This latter is bent entally, thus passing the basis of the diverticulum entering the wall of the muscular duct, and finally discharging into the ectal end of the middle part of the spermatheca.

REMARKS.—*D. navana* is characterized principally by the singular reduction of the sexual organs, which are neither strictly microscolecine nor strictly balantine, but exhibit an intermediate stage between these two ordinary forms of reduction.

#### *Dichogaster godeffroyi* Michaelsen

*Benhamia godeffroyi* MICHAELSEN, 1890a, p. 5.

*Dichogaster godeffroyi* MICHAELSEN, 1900, p. 354; 1908, p. 22, Pl. I, figs. 2, 3; 1934, pp. 63-64.

LOCALITY.—Haiti, Sanchez, March 6, 1915.

FURTHER DISTRIBUTION.—Haiti, Puerto Plata and Plaisance (according to Michaelsen, 1900 and 1908).

MATERIAL AVAILABLE.—A mature specimen, 65 mm. long, and a much smaller, half-mature one.

REMARKS.—The first distinct dorsal pore lies on the intersegmental furrow XII/XIII, a seemingly still closed pore at XI/XII [in the specimen from Plaisance each one segment more anteriorly].

The clitellum is saddle-shaped, ventrally interrupted, without sharp borders, at the segments XIII to XX (= 8) [in the specimen from Plaisance at the segment XIII (XIV) to XIX (= 6, if not 7)].

The male field shows a peculiarity not seen in the specimens previously examined. There are no longitudinal glandular walls accompanying the seminal furrows, but median-ventrally at each of the segments XVII and XIX is a longish, transversely oval, whitish glandular patch, occupying the whole length of the segment, and reaching laterally nearly as far as to the lines of setae *c*. The ends of the seminal furrows intrude into these glandular patches, which are well developed, especially in the half mature specimen. The seminal furrows are convex toward the median line as in the type specimen, not straight as in the specimen from Plaisance. This difference is perhaps not due to variability, but presumably caused by different post-mortem contraction.

The chylous pouches are much flattened kidney-shaped, with two or more deep incisions in the convex border.

The number of meronephridia may attain to eight in each side of a segment.

Remarkable is the length of the prostate ducts, which form some wide, regular serpentine undulations; those of the larger prostates in segment XVII being about 3 mm. long.

I could recognize no trace of penial seta in the new mature specimen, but I dare not assert that they were totally missing; they may have been torn out during copulation.

As for the spermathecae, I can confirm my note from 1934 (p. 64). In one of the larger hinder spermathecae as well as in a smaller one of the anterior pair, there were in each of the diverticula two or three seminal chambers, two of which lie one above the other, the smaller third one, sometimes present, lies beside them. The largest spermathecae are about 0.2 mm. wide.

### *Dichogaster itoliensis* Michaelsen

#### Forma typica

*D. jaculatrix* BAYLIS, 1915, p. 451.

LOCALITIES.—Belgian Congo, Medje at the river Nava, northern affluent of the Aruwimi, 2° 25' north lat., 27° 20' east long.; Lang-Chapin Congo Expedition, Niapu, November, 1913.

REMARKS.—*D. jaculatrix* Baylis from Ituri is identical with this widely distributed form, which is represented in nearly all collections from the northeastern Belgian Congo, from Uganda and the whole region of the Victoria Nyanza, and also in the present collection by many lots. Only the localities new for this form are noted above.

*Forma moorei* (Beddard)

LOCALITIES.—Belgian Congo, Lusonga in the Kivu district, 6000 ft., Chapin, Sage and Mathew Expedition, June, 1927.

**STUHLMANNIA MICHAELSEN** (emended)

*Stuhlmannia* MICHAELSEN, 1890, p. 24.

*Platydrilus* + *Stuhlmannia*, MICHAELSEN, 1891, pp. 11, 13.

*Metschiana* + *Stuhlmannia*, MICHAELSEN, 1903, pp. 462, 467.

DIAGNOSIS (emended).—Setae paired. Male pore unpaired, in segment XVII or in the intersegmental furrow XVI/XVII or XVII/XVIII. Spermathecal pore unpaired, in the spaces between the intersegmental furrows XII/XIII and XIV/XV. Female pores paired, laterally placed in segment XIV. A gizzard in the fifth segment. Paired oesophageal appendages resembling fat bodies in the sixth segment and some subsequent ones. Sexual organs holoandrous. Spermatheca unpaired, in connection or communication with the female organs, or if separated from them, at least near them.

TYPE.—*Stuhlmannia variabilis* Michaelsen, 1890, p. 24.

REMARKS.—In the older diagnosis *Stuhlmannia* was distinguished from *Platydrilus* (including *Metschiana*) on the ground that the ovaries were enclosed in coelomic tubes, while in *Platydrilus* they were said to lie free in the thirteenth segment. I now can no longer maintain the separation of these genera. The female apparatus and its connection with the spermatheca, as well as the forming of coelomic tubes and sacs is in this group so manifold, that it is not possible to draw a clear line of separation between them. It is principally a geographical circumstance, which decided me. The majority of the species of this group, about twenty-one species, are endemic in East Africa, westward as far as to the river Aruwimi (about 27° east long.) to Tanganyika (about 29° east long.), and to the Victoria falls of the Zambesi (about 26° east long.). Only in one direction, along the river Congo, four species of this group have extended farther westward into the Atlantic coastal region. These are, the new species *Stuhlmannia congica* (see below) from Stanleyville on the Congo (about 25° east long.), and three species from the coastal region close to and north of the mouth of the Congo, as follows: *Platydrilus inermis* Michaelsen (1910, p. 116) from Mayili in Belgian Congo (about 12° 30' east long.) which must now be called *Stuhlmannia mayiliensis* nov. nom., as *St. inermis* Stephenson has priority; *Platydrilus hortensis* Michaelsen (1910, p. 118) and *Stuhlmannia* [*Platydrilus*] *sandersi* Michaelsen (1910, p. 120, and 1913, p. 21), both from the river Chiloango in the Portuguese Congo (about 12° 8' east long.). These four Congo species differ in a remarkable point from the twenty-one East African species. In the latter the spermathecal pore lies, with much constancy, in segment XIII behind the intersegmental furrow

XII/XIII, at most going backward as far as the intersegmental furrow XIII/XIV, whereas in all the four Congo species this pore lies outside of segment XIII, mostly farther back (in *St. sandersi* and *Platydrilus inermis* [*Stuhlmannia mayiliensis*] at the intersegmental furrow XIV/XV, at *St. congica* at the intersegmental furrow XV/XVI, only in one species (*Platydrilus hortensis*) more anteriorly (at the intersegmental furrow XII/XIII). As *Pl. hortensis* is obviously allied to *Pl. inermis* [*Stuhlmannia mayiliensis*], I discussed the question of uniting it to the latter as a subspecies, for it is evident that the situation of its spermathecal pore means only an instance of atavism, overlapping a little the original space determined by the twenty-one East African species. It is clear that the four Congo species form together a group of near allies. Incidentally this destroys justification for separating *Stuhlmannia* and *Platydrilus*, for in this small group there are species showing both characters: with free and with enclosed ovaries.

*Stuhlmannia congica*, new species

Figures 4, 6, 7

LOCALITY.—Belgian Congo, Stanleyville, 0° 30' north lat., 25° 10' east long. found in the company of two different species of *Alma*, therefore presumably limnetic; Lang-Chapin Congo Expedition, 1915.

MATERIAL AVAILABLE.—Many well-preserved specimens. Type, Cat. No. 2252, American Museum of Natural History.

DESCRIPTION.—Dimensions of mature specimens: length 40–60 mm., width in the smallest 0.6–1.2 mm., in the largest 0.6–1.5 mm. The middle part of the fore body, which is sometimes a little swollen, may be as wide as 1.8 mm. Number of segments 100–114.

Color warm brown, more or less dark dorsally, but only a little darker than ventrally.

Form slender; the middle and the hinder body especially so.

Head epilobous (about  $\frac{1}{3}$  to  $\frac{1}{2}$ ). Prostomium rounded, its dorsal appendage nearly quadrate, the acute posterior corners connected by a transverse furrow. Outlines of the appendage are continued backward by more or less distinct longitudinal furrows reaching at the most to the middle zone of segment I.

Segments simple, without secondary annulation furrows.

Setae rather stout, rather strictly paired; approximately  $aa:ab:bc:cd = 1:3:1:3$ ;  $dd =$  about four-sevenths of  $u$ .

Clitellum (Fig. 7) from  $\frac{1}{4}$  segment XIII or XIV to  $\frac{1}{4}$  segment XVII or XVIII ( $= 4\frac{1}{4} - 4\frac{1}{2}$ ), distinctly saddle-shaped, ventrally interrupted, here sharply bordered by more or less distinct longitudinal furrows between the lines of the setae  $a$  and  $b$ . The ventral pairs of setae are situated just in these border lines, and usually the median ventral part of the body is somewhat depressed at these border lines, and somewhat convex in the space between them. The intersegmental furrows are nearly totally obliterated on the clitellum. The color of the clitellum is mostly dark purplish brown.

Male pore (Figs. 6, 7) situated median ventrally at segment XVII; an irregular cross- or star-shaped slit at the top of a circular, more or less prominent male porophore, which is sometimes somewhat inclined forward, the base of which occupies nearly the whole length of segment XVII.

Female pores (Figs. 6, 7) rather inconspicuous, but sometimes marked by dark points among minute spots, distinguished from the dark clitellum by their lighter color. The pores lie behind the setal zone of segment XIV, somewhat above the line of setae *b*.

Spermathecal pore (Figs. 6, 7) placed median-ventrally at the intersegmental furrow XV/XVI, a broad, deep transverse slit, anteriorly and posteriorly bordered by broad transverse prominences, which often are lip-like, and occupy the posterior half of the fifteenth and anterior half of the sixteenth segment as far as the zones of setae, laterally reaching the lines of seta *a*.

Accessory organs of puberty (Figs. 6, 7): A transversely square or transversely biscuit-shaped cushion of puberty on the median ventral anterior part of segment XVIII, laterally reaching the lines of setae *b*. At the anterior part of segment XIX a pair of circular cushions of puberty, corresponding in situation to the lateral enlargements of the biscuit-shaped cushion of segment XVIII. Sometimes there are narrower transverse cushions closely pressed together median ventrally on the posterior part of the sixteenth and, less distinct, on the fifteenth segment.

All these external sexual organs vary in degree of development, being sometimes only indistinct; most distinct in sharply contracted hardened specimens.

Septa V/VI to XI/XII thickened in their middle parts, V/VI to VIII/IX rather strongly, the subsequent ones gradually less thickened. Toward the ectal edge these septa become very thin. The septum XII/XIII is pushed backward, and inserted between the intersegmental furrow XII/XIII and the setal zone of the thirteenth segment. The septum XIII/XIV on the contrary, is displaced somewhat forward and perhaps made incomplete. From its ventral border it is inclined obliquely forward and in about the middle of its height joined to the septum XII/XIII, thus reducing the thirteenth segment to a small ventral chamber, an ovarian chamber. In some slides I believe it possible to see that the thin membrane, the somewhat questionable septum XIII/XIV, after its connection with septum XII/XIII again separates itself from the latter, and continues to form a dorsal part of septum XIII/XIV, inserting itself dorsally and posteriorly on segment XIII. But this could not be seen clearly.

Alimentary canal: A moderately large gizzard in the fifth segment. Oesophagus narrow, tubular and of equal diameter throughout. From its wall bolt-shaped processes regularly arranged in annulations project into the lumen. In segments VI to VII seven pairs of appendages resembling fat bodies, and each containing a blood-vessel, depend laterally from the oesophagus.

Anterior male organs holandrous. Two pairs of testes and male funnels ventrally in segments X and XI embedded in free masses of spermatogems. Two pairs of short multiple seminal vesicles with large chambers depend from the septa X/XI and XI/XII into segments XI and XII.

Posterior male organs (Fig. 6): Euprostates (*eu*) sausage-shaped, straight or a little bent, about 1.6 mm. long and 0.3 mm. wide, entally regularly rounded, at the ectal and rather rapidly narrowed and united and continued into a common duct, which passes through the male porophore to discharge through the male pore as its end. Externally the euprostates are quite smooth, without luster. Their external

layer of muscles is very slight, the inner layer thick and seemingly glandular, the lumen is regular, simple and rather narrow, but not tubular; its contour in a transverse section is spindle-shaped or elongate and narrowly oval. The short, thin duct is more muscular, and has a very narrow axial channel. I could not surely demonstrate the entrance of the male ducts into the euprostates; but doubtless it occurs at or near the ental pole of the euprostate. The surface of the ental part of each shows two thin longitudinal walls, separated from each other by a short but distinct intermediate space. These walls were pressed outward by a very narrow male duct about  $30\mu$  thick, lying close beneath the external covering-membrane of the euprostate. I could follow the male ducts entally nearly as far as to the ental pole of the euprostate. Close beside and a little anteriorly to the male pores a pair of slender penial setal sacs (*ps*) discharge, each containing two penial setae. The penial setae (Fig. 4) are slenderly S-shaped, only a little bent in the ental half, the ectal half being bent somewhat more and in an opposite direction. They are about 1.3 mm. long, entally about  $38\mu$  thick, in the middle about  $34\mu$  thick, and slowly diminishing a little more toward the ectal part, ending in a simple, moderately acute tip. The ectal third of the seta is somewhat flattened in the plane of the curvature, but not broadened. The transverse section of this part of the seta has a slender oval contour. There is no trace of any sort of ornamentation.

Female organs (Fig. 6): Two slender ovaries of tuft-like form (*o*) are inserted close to the median ventral line (yet beneath the ventral nerve-cord) at the border of septum XII/XIII and extend obliquely laterally into the ventral chamber formed by the septa XII/XIII and XIII/XIV and representing presumably the whole thirteenth segment, or perhaps only the ventral part of it (see the description of the arrangement of the septa given above). The female ducts (*fd*), discharging laterally at the hinder part of the fourteenth segment, are very slender in their ectal part, thickening by degrees entally, and run forward in a slightly meandering manner, each forming here a moderately long and thick, narrow loop, which pierces the thin septum XIII/XIV and thus enters the ventral ovarian chamber. The backwardly extending ental branch of this loop bears at its ental end a little pear-shaped sperm chamber (*sr*), and then forms close to the septum XIII/XIV some short meanderings, and opens into the ovarian chamber by a narrow slit. This part of the organ represents the female funnel (*ff*). As in some other species of *Stuhlmannia*, the female organs are not built quite symmetrically. A normal egg sac (*es*) is formed only in the apparatus of one side, projecting from the female funnel backward into the fourteenth segment. It is externally very uneven, mulberry-shaped, with relatively large, freely projecting egg-chambers. A short, narrow tube with moderately wide lumen, coming from the female funnel, if not from the ental end of the female duct, enters the small central lumen of the egg-sac. The apparatus of the other side lacks an egg-sac totally, or has it represented only by a rudimental organ, containing no more than two or three egg-chambers. I could not recognize any communication or connection between this female apparatus and the spermatheca.

Spermatheca (*sp*) unpaired. The opening between the more or less prominent lips of the spermathecal pore leads into a thick muscular bulb (*sb*) with a narrow axial channel. This bulb projects into the middle part of a highly vaulted, rather broad spermathecal atrium (*sa*). The anterior part of this atrium pushes the thin septum XIV/XV forward. The wall of the atrium is moderately thick, not muscular, in general even and smooth. Only at the anterior part it shows a transformation;—

some projections and excavations, which are marked by shallow furrows. The anterior end of the atrium is not smoothly rounded. Apparently it is continued into a fibrous cord, if not into a tubular organ; but I could not detect any connection between this cord or tube and the ovarian chamber, which it seems to reach, but not to enter. At the posterior end the spermathecal atrium narrows, and is continued into a narrow (about 0.26 mm.) thin-walled, tube, which runs almost straight backward and finally ends in an apulla (*sp*) about 0.6 mm. thick. The whole spermathecal apparatus has a length of about 5 mm. Its lumen contains a long, nearly cylindrical thecocyst, the hinder end of which, in the ampulla, is of capitate form, and the fore end, in the anterior part of the spermathecal atrium, is also considerably thickened.

***Eminoscolex navanus*, new species**

Figures 11, 12

LOCALITY.—Belgian Congo, Medje at the river Nava, northern affluent to the river Aruwimi, 2° 25' north lat., 27° 20' east long.; Lang-Chapin Congo Expedition.

MATERIAL AVAILABLE.—Three mature specimens and one half-mature one. Type, Cat. No. 2253, American Museum of Natural History.

DESCRIPTION.—Dimensions of the mature specimens: length 65 mm., thickness at the hinder body about two mm., at the fore-body as much as three mm. Number of segments 140–150. The half-mature specimen is very much smaller.

Color dorsally smoke brown, rather dark, gradually becoming reddish gray and lighter ventrally.

Head epilobous, nearly tanylobous. Prostomium small, heart-shaped. Dorsal appendage of prostomium long and very narrow, with parallel borders, which nearly reach the intersegmental furrow I/II but get very narrow and indistinct at the ends. Segments simple, not annulated.

Setae moderately stout, paired, the ventral ones very distant from each other, the dorsal ones rather near each other, the middle-lateral distances being relatively very small, hardly greater than the distance between the dorsal setae. Median-dorsal distance nearly equals the half circumference of the body. (At the middle of the body  $aa:ab:bc:cd:dd$  approximately equals 6:5:1:1:20.)

Nephridiopores close below the lines of setae *d*.

Clitellum dark purple-brown ring-shaped on segments XIII to XVIII (= 6), feebly developed on the thirteenth and eighteenth segment.

Sexual pores all inconspicuously paired.

Secondary male pores in the bottom of hardly recognizable enlargements of the intersegmental furrow XVII/XVIII above the lines of setae *b*.

Female pores in the intersegmental furrow XIV/XV in the lines of setae *c* or near them (recognized only in sections).

Spermathecal pores. Long, but narrow slits in the intersegmental furrow XXI/XIII above the lines of setae *b*.

Septum V/VI thin, VI/VII rather thin, VII/VIII to XI/XII moderately thick, the succeeding ones thin.

Alimentary canal: A rather large gizzard in the fifth segment. Three stout pear-shaped unpaired chylous pouches depend ventrally in the ninth, tenth and eleventh segments from the oesophagus. They are paniced tubular pouches without a distinct basal lumen; with very numerous, perhaps 200 or more, chylous tubes,

pressed together closely and parallel. Paired chylous pouches, lamellar pouches, laterally on the oesophagus in the thirteenth segment. Intestine without a typhlosole.

Anterior male organs holoandrous. Two pairs of massive seminal vesicles, having short stalks, depending from the septa X/XI and XI/XII into the eleventh and twelfth segments; they are broad and short sacs, externally uneven. Two pairs of sperm reservoirs in the posterior part of segments X and XI, lateral to the oesophagus. They are light yellowish white, with a metallic luster, being densely filled with sperm. Their main part is bluntly club-shaped, thickest in the upper part, with not quite regularly alternating lateral incisions inclining to a serpentine form. Their ends are continued into moderately long, thin, irregularly bent tubes. The tubes at the upper end pierce through the succeeding septum (X/XI or XI/XII) and enter the seminal vesicles, here ending in rather small male funnels. The tubes at the lower end extend backward and are continued into typical male ducts.

Posterior male organs (Fig. 12): Opening the worm by a dorsal longitudinal incision, spreading the body-wall, and removing the intestine, there are visible, in addition to the ventral nerve cord, two thick cylindrical muscular organs with a lustrous surface, extending backward from each male pore through several segments. They lie parallel to each other and are approximately equal in length (about 5 mm.) and width (about 0.7 mm.). The medial one is the glandular part of an euprostate (*eu*), the lateral one a penial pouch (*pp*). The entally regularly rounded euprostate (*eu*) has a simple, rather narrow lumen, in a transverse cleft with a flattened-elliptical contour; it is invested with a thin, smooth epithelium of very delicate and slender cylindrical cells. Externally the euprostate is enveloped by a moderately thick muscular mantle. The thick layer between this mantle and the epithelium is built up of slender, radially arranged glandular cells: I could not recognize with complete certainty at what point the male ducts (*md*) enter the lumen of the euprostate; but I saw in the glandular layer of the ental end of the euprostate a curved cord, crossing the radially placed glandular cells, and obviously tending toward the ental end of the lumen of the euprostate. I can hardly be mistaken in considering this cord as a tangential section through a male duct, which enters the ental end of the euprostatic lumen. The ectal end of the glandular part of the euprostate narrows conically, and is continued into a thin tube-like, muscular duct. After some irregular serpentines this duct enters the wall of the penial pouch (*pp*) rather close above the ectal end of it. The wall of the penial pouch is muscular, but the muscles, which are principally transverse, do not form a dense, firm mantle as on the glandular part of the euprostate. The ental end of the penial pouch is not rounded, but is continued into a muscular tuft, soon getting narrower and presumably serving as a retractor of the penial pouch. Yet it must be noted that I could not determine whether this tuft was inserted at the body-wall. The lumen of the penial pouch is rather wide, with an approximately circular outline. The duct of the euprostate, entering the penial pouch near its ectal end, extends, soon getting thinner, in the wall of the pouch nearly as far backward as the ental end of the penial pouch. Here, becoming thicker again, it turns in a sharp bend inward and ectally, and enters the lumen of the pouch, forming the ental end of a penis. The penis (*p*), thus inserted in the ental end of the penial pouch, is very long, and so thick that it nearly fills the lumen of the pouch throughout its length. It shows many narrow serpentines, only marked by alternating incisions in its flanks. Stretched out, it would be conspicuously longer than the



pouch. Toward its ectal end it gets gradually thinner and finally ends in a narrowly rounded tip. I could not detect any muscular elements in the penis. The main part of its wall is formed of very delicate radially arranged fibres of questionable nature. Its lumen, the continuation of the euprostate axial channel, is very narrow, invested by a very fine epithelial layer, and discharges at the ectal tip through the primary male pore. Doubtless the penis is pushed out during the copulating act, to enter the spermathecal atrium. As it has no noticeable muscles, its entrance into the spermatheca must be regarded with more probability as taking place by being drawn in by the muscular spermathecal atrium. This euprostate apparatus recalls the corresponding organs of *Malodrilus neumanni* Michaelsen (1903, p. 473, Pl. xxiv, fig. 14). But in that species euprostate and penial pouch are not parallel to each other, each being curved in circular form one behind the other, and the euprostate duct enters, not the ectal, but the ental end of the penial pouch.

Female organs and spermathecal apparatus (Fig. 11). The spermathecal pores lead each into a large, cylindrical, muscularly lustrous spermathecal atrium (*sa*), the ectal end of which is narrowly conical, whilst entally, after narrowing a little in the beginning, it is continued into a thick pear-shaped ampulla. The spermatheca first extends a little toward the median line from its discharging pore, then bends upward and soon backward through several segments as far back as to the region of the euprostates, overlapping the female organs in segments XIII and XIV. The wall of the spermathecal atrium is very thick, muscular, with a moderately wide lumen, and narrowed longitudinal septum-like prominences. The ampulla has a thin wall, and in the specimen examined is filled by a rather coarse granular mass, colored dark red by haematoxylin-eosin. Medial to the ascending part of the spermathecal atrium a large, somewhat irregularly formed ovarian bladder (*ob*) is attached, the medial wall of which is rather far separated from the ventral nerve-cord (*vn*). This ovarian bladder which reaches, without diminishing in width, as far as the septum XIII/XIV, is almost completely filled by a large, lobed ovary (*o*) and a massive, rolled up female funnel (*ff*) lying in its posterior part. The lumen of this funnel shows the complicated structure usually found in the eudrilines. At its broader medial pole the funnel seems to open by a narrow slit into the ovarian bladder (not quite distinctly seen). At its posterior side it bears an egg sac with a short and narrow stalk (*es*), projecting into the fourteenth segment. The surface of the egg sac is made very uneven by the projecting egg chambers, each containing an egg cell about  $25\mu$  in diameter. The more contracted lateral pole of the female funnel, narrowing conically, is continued into the female duct (*fd*). At the indistinct demarkation between female funnel and duct, and posterior to them, there is a small, widely pear-shaped sperm chamber (*sr*), projecting only a little, and discharging ectally into the female duct. This duct, at first conically narrowed, soon bends backward and extends, getting thinner and thinner, and clinging to the body-wall, as far as the intersegmental furrow XIV/XV. There it bends laterally and pierces the thick body wall perpendicularly, discharging finally through the narrow female pore. I could not recognize any communication between the spermatheca and the female organs, which are closely adherent to it.

***Eminoscolex langi*, new species**

Figures 1, 10

LOCALITY.—Belgian Congo, Medje at the River Nava, northern affluent of the Aruwimi River,  $2^{\circ} 25'$  north lat.,  $27^{\circ} 20'$  east long.; Lang-Chapin Congo Expedition.

**MATERIAL AVAILABLE.**—A specimen without clitellum, but otherwise mature, having already copulated, which is the type (Cat. No. 2254, American Museum of Natural History).

**DESCRIPTION.**—Dimensions: length 110 mm., thickness throughout most of length 3.5 mm.; number of segments about 156.

Color brownish gray, dorsally only a little darker than ventrally.

Body cylindrical. Head epilobous (about  $\frac{2}{3}$ ). Dorsal appendage of prostomium posteriorly closed by a transverse furrow, the lateral borders a little converging backward.

Setae moderately stout, at the middle part of the body 0.35 mm. long and  $25\mu$  thick, slightly curved in an S-form, with a nodule somewhat ectal to the middle point. The ventral setae are widely paired, almost separated; the dorsal setae are rather strictly paired. The middle lateral distances are about equal to the median ventral; the median-dorsal distance approximately equals half the circumference of the body. At the middle part of the body  $aa:ab:bc:cd:dd$  approximately equals 8:6:8:3:42.

Nephridiopores between the lines of setae *c* and *d*.

Dorsal pores are wanting.

Clitellum not yet developed.

Sexual pores all inconspicuous, paired.

Secondary male pores at the intersegmental furrow XVII/XVIII, between the lines of setae *b* and *c* in the bottom of hardly noticeable widenings of the intersegmental furrow.

Female pores only seen in a series of longitudinal sections. They are placed at the intersegmental furrow XIV/XV between the lines of setae *c* and *d*, approximated to the latter.

Spermathecal pores at the intersegmental furrow XII/XIII, just above the lines of setae *b*; and resembling the secondary male pores in appearance.

Septum V/VI very thin, VI/VII a little thicker, VII/VIII to XI/XII rather thick, XII/XIII moderately thin.

Alimentary canal: A large elongate barrel-shaped gizzard in the fifth segment. Oesophagus equally and moderately wide. In each of the ninth and tenth (as well as in the eleventh (?)) segment a thick, club-shaped unpaired chylous pouch depends from the ventral side of the oesophagus, being attached to it by the thinner ental end. I did not recognize such a pouch in the eleventh segment. Presumably it was torn off and lost when I dissected the worm. The unpaired chylous pouches are paniced tabular pouches without a distinct basal lumen, with very numerous, thin chyle tubes, lying parallel and pressed together. In segment XIII two thick, irregularly kidney-shaped paired chylous pouches with some incisions in the convex border, are situated at the sides of the oesophagus. They are pouches with broad, closely arranged ridges. The intestine begins in the fifteenth (?) segment with a sudden enlargement. It has no typhlosole.

Anterior male organs holoandrous: Two pairs of seminal vesicles depend backward from the septa X/XI and XI/XII. Those of the anterior pair are restricted to the eleventh segment; they are irregularly sac-like, moderately long, with a thin, upwardly bent basal part and a broad, backwardly bent middle and apical part, with some deep incisions. The seminal vesicles of the hinder pair have a quite different form. They reach backward as far as the twenty-first segment, if not farther. In piercing the septa, they are thin and tubular, in each of the intervening segmental

parts they enlarge to a pair of flat, nearly semicircular, lateral pouches, the whole organ having somewhat the appearance of a fern leaf, the arrangement (but not the contour) of the side-leaves resembling that of the common *Polypodium*. Two pairs of sperm reservoirs in the tenth and eleventh segments; they are thin-walled tubes, partly moderately wide, partly very wide, irregularly wound and meandering, the windings being pressed together to form a nearly compact elongate mass with an irregular contour. The ental ends of the sperm reservoirs, piercing the hinder septa of their segments, enter the seminal vesicles.

Posterior male organs (Fig. 10): The glandular part of each euprostate forms a narrow loop, stretching straight backward as far as to enter segment XXIII. The ental branch of this loop is a little shorter than the ectal one, to which it is closely adherent. The free edges of these somewhat flattened branches are deeply incised in the intersegmental parts, but expand in a nearly semicircular outline in the segmental parts. The glandular part of the euprostate has a thick glandular layer and a narrow axial canal, but no noticeable muscle layer. The two male ducts (*md*) of one side are closely joined to each other, but not united. They enter the regularly rounded top of the ental branch of the glandular part of the euprostate. The ectal branch of the latter is continued into a much thinner, moderately long duct, which runs straight forward. This duct is externally smooth and its mantle contains muscles which are mostly longitudinal. The rather narrow axial canal is bent in some broad undulations. The duct then enters a nearly globular bulb (*mb*), which must be regarded as a muscular penial pouch (*pp*). It appears to consist mainly of irregularly felted muscles which cannot be separated distinctly into transverse and longitudinal ones. The lumen of the penial pouch is narrow, totally restricted to the ectal part of it, and nearly filled by a broad, obtuse conical penis. The axial canal of the euprostate, after piercing the bulb of the penial pouch, discharges through the primary male pore at the rounded apex of the penis.

Female organs and spermatheca (Fig. 1): Each spermathecal pore leads into a short thick tubular spermathecal atrium with a thick muscle layer and a narrow axial canal, a transverse section of which shows an irregularly stellate contour. Soon after, having entered the body cavity, this atrium enlarges to a thin-walled ampulla (*sp*), egg-shaped in the ectal half, (*sp*). It is about 1.8 mm. thick, and is continued entally into a tubular part nearly equally long and about 0.6 mm. thick, which gets still thinner at the incurved extreme end. The wall of the ampulla is rather thin. The material contained in the ampulla is peculiar. It consists mainly of spermozeugmas of a more or less regular cylindrical or club-shaped form. They are about  $\frac{1}{3}$  mm. long and  $75\mu$  thick. Their apparently structureless axial cord is densely and regularly beset with obliquely arranged spermatozoa, the slender tails of which project freely. These spermozeugmas do not lie irregularly in the lumen of the ampulla, but are attached to the wall of the ampulla by their thinner end and form a close investment about it. Only in the spacious ectal half of the ampulla do they project straight into the lumen, but they leave the inner part of it free. In the narrower tube-like part they fill the whole space, being closely pressed together and irregularly bent and curved to accommodate themselves to the available space. The free middle part of the ectal half of the ampulla contains delicate granulations, doubtless secretions of the glandular cells of the ampulla. The whole spermatheca is enveloped by a very thin coelomic membrane (*c*), which is attached to it quite closely only at its basal part, and which presumably is in connection with the ovarian blad-

der. At each side of the ventral nerve-cord an ovary (*o*) is attached at the margin of septum XII/XIII, and extends from here obliquely laterally into the thirteenth segment. The ovary is narrow at its base, very much enlarged in its middle and apical parts. The largest egg cells of the ovary (already partly free) are about  $25\mu$  in diameter. The ovary is rather closely enveloped in a thin-walled ovarian bladder (*ob*), which is entally continued into a short and moderately wide ovarian tube. This soon enlarges to a moderately wide female funnel bladder. The thin wall of the latter extends backward, here enveloping the medial side of the neighboring spermatheca, or rather, the thin coelomic envelope of it. Presumably the lumen of this ental part of the female funnel bladder is in communication with the spermathecal chamber, formed by the coelomic membrane enveloping the spermatheca. In its lateral part the female funnel bladder contains a bluntly pear-shaped, rolled up female funnel (*ff*). The broad medial pole of this funnel opens through a narrow slit into the female funnel bladder, while the narrower lateral pole is continued into a thin female duct (*fd*). This duct extends a little way laterally and then bends upward and backward, and finally discharges, after piercing the body wall in a straight transverse direction, through the corresponding narrow female pore. The female funnel bears at its hinder wall a kidney-shaped egg-sac (*es*), which is externally very uneven because of the projection of the egg chambers. The short, narrow stalk of the egg sac pierces the wall of the female funnel bladder, in connection with septum XIII/XIV, so that the egg sac projects into segment XIV. At the point where the female duct joins the female funnel a simple, widely pear-shaped sperm chamber is developed which projects only a little over the posterior side of the female funnel.

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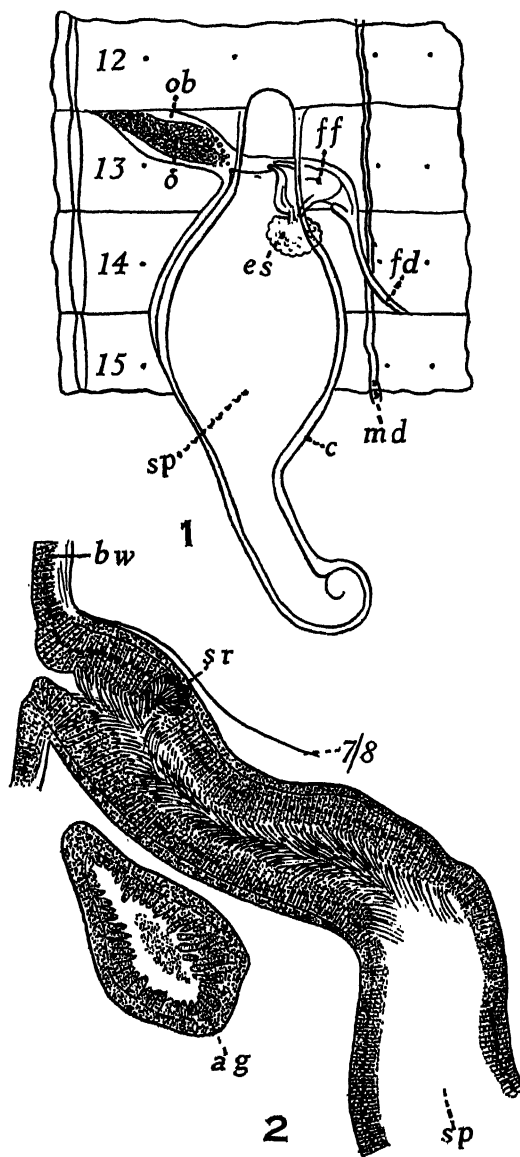


Fig. 1. *Eminoscolex langi*. Female organs and spermathecal apparatus of the right side (schematic),  $\times 15.9$ .

c, coelomic membrane enveloping the spermatheca; es, egg sac; fd, female duct; ff, female funnel; md, male duct; o, ovary; ob, ovarian bladder; sp, spermatheca.

Fig. 2. *Andiorrhinus duidanus*. Longitudinal section through the ectal part of a spermatheca,  $\times 62$ .

ag, accessory glandular pouch; bw, body-wall; sr, sperm chamber; 7/8, septum VII/VIII.

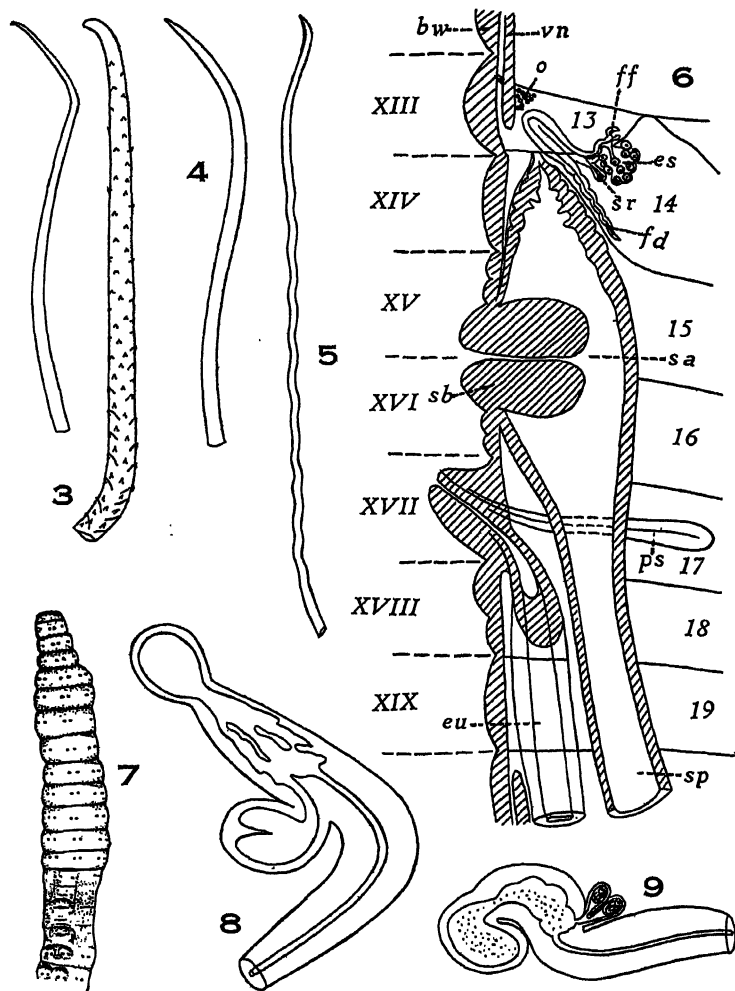


Fig. 3. *Dichogaster navana*. Penial seta,  $\times 33$ , and ectal part of the same,  $\times 165$ .

Fig. 4. *Stuhlmannia congica*. A penial seta,  $\times 52.3$ .

Fig. 5. *Dichogaster chapini*. Ectal part of a penial seta,  $\times 146.6$ .

Fig. 6. *Stuhlmannia congica*. Right side of the ventral part of the body in the sexual region, opened by a main sagittal section,  $\times 33$ . The plane of the section is distinguished by hatching.

*bw*, body-wall; *es*, egg sac; *eu*, euprostate; *fd*, female duct; *ff*, female funnel; *o*, ovary; *ps*, penial seta sac; *sa*, spermathecal strium; *sb*, spermathecal bulb; *sp*, spermatheca; *sr*, sperm chamber; *vn*, ventral nerve-cord.

Fig. 7. *Stuhlmannia congica*. Fore body from the ventral side,  $\times 5.8$ .

Fig. 8. *Dichogaster navana*. Spermatheca, shown as though transparent,  $\times 29.3$ .

Fig. 9. *Dichogaster chapini*. Spermatheca shown as though transparent,  $\times 40.3$ .

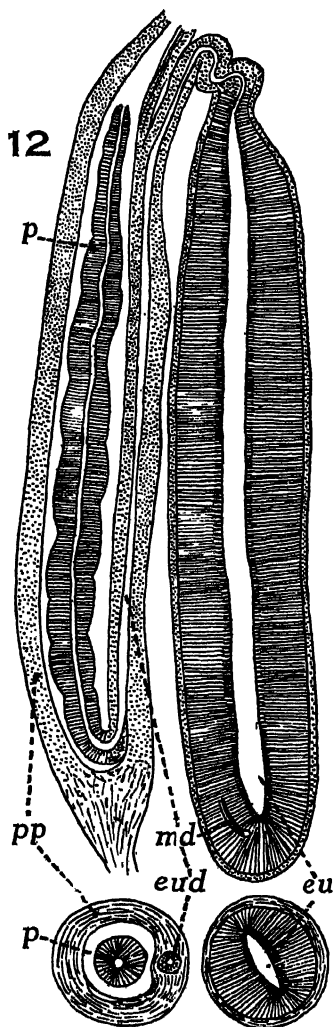
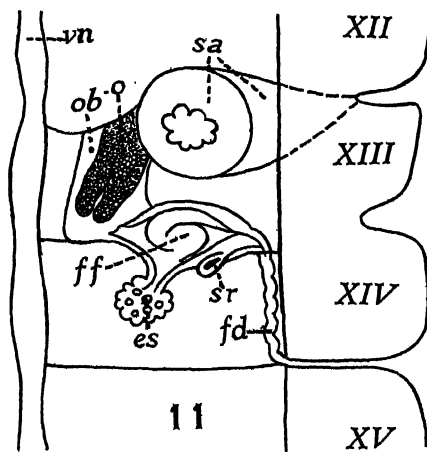
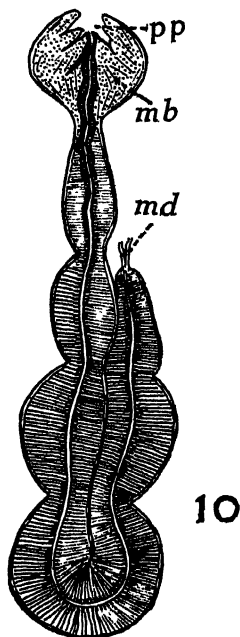


Fig. 10. *Eminoscolex langi*. Euprostate apparatus in an optical horizontal section (schematic),  $\times 15.2$ .

mb, muscular bulb; md, male ducts; pp, penis pouch.

Fig. 11. *Eminoscolex navanus*. Ventral part of the right side of the sexual region, opened by a horizontal section, which cuts off the ental part of the spermatheca. (schematic),  $\times 25.4$ .

es, egg sac; fd, female duct; ff, female funnel; o, ovary; ob, ovarian bladder; sa, spermathecal atrium; sr, sperm chamber; vn, ventral nerve cord.

Fig. 12. *Eminoscolex navanus*. Longitudinal and transverse section through the euprostate-penial apparatus,  $\times 22$ .

eu, euprostate; eud, euprostate duct; md, male duct; p, penis; pp, penis pouch.





WESTERN BEES OF THE GENUS *CERATINA*, SUBGENUS  
*ZAODONTOMERUS*

BY CHARLES D. MICHENER

The species of this group are similar, and extensive use must be made of minor characters of punctuation and color to separate the species. Yet these characters, along with nearly all the others, are variable within certain limits. The shape of the apex of the seventh sternite of the males, supposedly very constant, is in reality somewhat variable, particularly in *C. nanula* and *neomexicana*. The variability of the sculpture found on the enclosure of the propodeum is remarkable (see figures). The same variations seem to be found in all the species. Yet in other genera, *Halictus* for example, these characters are apparently of specific value. (See, however, *Augochlora azteca transversalis* Sandhouse and Cockerell.) The male genitalia are useful in distinguishing most of the species, but *C. acantha* Provancher, its subspecies *submaritima* (Cockerell), *nanula* Cockerell and its new subspecies *rigdenae* all have similar genitalia shown for *nanula*.

The area covered by this paper is northern Mexico and the United States except the eastern part. Within this region, the greatest concentration of forms is in California, where ten species and subspecies are found. Probably some species, for example *C. acantha submaritima* (Cockerell), extend into Canada, but I have not seen specimens from there.

I wish to thank Prof. T. D. A. Cockerell for valuable suggestions, for the use of his collection and literature, and for the opportunity to work over some of the collections of The American Museum of Natural History. Types of the new forms described in this paper will be found in the American Museum.

*Ceratina sequoiae*, new species

## Figure 8

FEMALE.—Length, 6 to 8.5 mm. (all but one over 7 mm.); strongly greenish, without blue. Tubercles, a short vertical mark on clypeus, and dots at bases of fore and hind tibiae pale yellow. Center of clypeus impunctate, the edges with a few coarse ill-formed punctures; labrum with numerous small punctures; front impunctate except for a few punctures close to the ocelli and eyes; vertex with rather

sparse, not very coarse punctures, becoming gradually finer on the cheeks as one proceeds downward, until they are exceedingly fine below, especially in large specimens; impunctate band next to posterior orbital margin widened below in large specimens. Labrum, mandibles, antennae, and lower part of cheeks black, without greenish; under side of flagellum faintly brownish. Eyes divergent below, or parallel in small specimens; clypeus low. Scutum finely and sparsely punctate anteriorly, more coarsely and closely punctate on sides where it approaches the tubercles and on the lateral and posterior margins, and impunctate on disk except anteriorly; scutellum and postscutellum finely punctate, closely so except for the center of the scutellum, where the punctures are sparse, as on anterior part of scutum; propodeum very finely and closely punctate on sides and posterior face; pleura very closely and coarsely punctate, the punctures as close as they can be except posteriorly. Tegulae dark brown; disk of scutum, and legs except for parts of the femora, with very little greenish color, the former a little purplish; wings rather dark reddish brown, the stigma and veins black. Abdomen moderately coarsely and closely punctate except for the nearly impunctate first tergite (which has some fine punctures near apex); disks of some of the median tergites a little more finely punctate than sides; profile of sixth tergite convex with a rather large concavity in the distal half; venter of abdomen a little more coarsely punctate than dorsum, with brownish-black margins on some of the sternites; segment one, in most lights, and a semilunar basal median area on sternites two and three black.

California.—Hospital Rock, Sequoia National Park, September 4, 1933. Eight specimens on *Stachys ajugoides* and one on dove weed (Michener).

This runs to *neomexicana* (Cockerell) in H. S. Smith's key, but that is nearly always bluer; almost always with paler wings; punctures of pleura smaller and better separated posteriorly, even in the coarsely punctate forms. *C. sequoiae* differs from *melanoptera* Cockerell, another dark-winged form, by the densely punctured pleura, etc.

#### *Ceratina metallica* H. S. Smith

Texas.—Brownsville, June (Wickham), and one without definite locality (Wheeler).

Two of the three females which I have seen have only spots of yellow at bases of fore tibiae, not lines as stated by Sandhouse (1935).

See notes under *C. strenua* F. Smith.

#### *Ceratina nanula* Cockerell

Figures 9, 11, 17

Mexico.—Juarez, Chihuahua, May 12 (Cockerell).

New Mexico.—La Cueva, Organ Mountains, 5300 feet elevation (Townsend); Dripping Springs, Organ Mountains, on thistle, August 19 (Townsend and Cockerell); Mesilla, August 13 (Cockerell); Mescalero, July 22, 1898 (C. M. Barber).

Colorado.—Colorado City, May 10, 1904 (T. D. A. and W. P. Cockerell); Starkville, June 13, 1919, 6800 feet elevation, 37° 6' N., 104° 30' W. (F. E. Lutz); Boulder, on *Aragalus lambertii*, *Viola nuttallii*, yellow *Ribes*, *Astragalus goniatus*, and *Besseyia plantaginea* on dates ranging from April 28 to June 21 (Lutz, Rohwer, and M. D. and M. M. Ellis); Mesa Verde, July 3–7, 1919, 7300 feet elevation, 37° 12' N., 108° 29' W., at flowers of *Calochortus gunnisonii* (F. E. Lutz); Tennessee Pass, July 30–August 2, 1919, 10,300 feet elevation, 30° 22' N., 106° 19' W. (H. F. Schwarz).

Wyoming.—Cheyenne, June 11, 1920, 6000 feet elevation, 40° 8' N., 104° 49' W. (F. E. Lutz).

Idaho.—Paris, July 8, 1920, 6000 feet elevation, 42° 14' N., 111° 25' W. (F. E. Lutz).

Males have the apical plate of the abdomen not just as figures by H. S. Smith, but showing an approach toward his figure of *metallica* H. S. Smith. However, it is slightly variable. Specimens from southern New Mexico average slightly bluer than most of the Colorado specimens. Also, they often have paler wings. It may be that we have two slightly differentiated subspecies.

### *Ceratina nanula rigdenae*, new subspecies

Figures 1, 2, 3

FEMALE (type).—Length, 4.5 to nearly 7 mm.; greenish. Tubercles, a short vertical mark on clypeus (sometimes much reduced), and dots on knees pale yellow. Head punctured and marked almost as in *sequoiae* Michener but punctures on vertex more numerous and coarser. Eyes convergent below. Scutum impunctate on disk posteriorly, but anterior half of scutum and a band all the way around the edge rather closely punctate, most sparsely on anterior half; scutum and scutellum moderately punctate, the scutellum more sparsely so medianly; sides and posterior face of propodeum very finely punctate; pleura rather coarsely punctured, but not so coarsely as in *sequoiae*, some shining surface showing between the punctures. Impunctate part of scutum black with a purplish tinge. Legs black; the femora greenish. Tegulae dark brown; wings nearly clear, but darker than typical New Mexico *nanula* Cockerell, the veins and stigma black or very dark brown. Abdomen sculptured and marked as in *sequoiae*, but perhaps a little more coarsely punctate dorsally; a large part of profile of sixth tergite concave.

MALE.—Length, 3.5 to 5.5 mm.; similar to the female but perhaps a little bluer. Clypeus with the usual pale mark, the arms about equal in length; labrum usually with a pale spot; cheeks more coarsely and closely punctate. Apex of abdomen somewhat variable, about as in H. S. Smith's figure of *metallica*, somewhat intermediate between that and *nanula*, but perhaps nearer to *metallica*; hind femora produced to an obtuse angle.

California.—Big Bear (San Bernardino Mountains) (type locality),

in hollow stem (I. Wilson); Mountain Home Creek (San Bernardino Mountains), June 17 (Cockerell); Kenworthy, San Jacinto Mountains, June 8 (F. Grinnell, Jr.); Sandhills, Pacific Grove, July 3 (Cockerell and Moore); Eagle Rock Hills, Los Angeles County, April 14, 1933, and from nest December 20, 1933 (Michener); mouth of San Antonio Canyon, Los Angeles County, April 2, 1933 (Michener); San Gabriel Canyon, Los Angeles County, June 22, 1932, and May 26, 1933 (Michener); Pine Valley (San Diego County), June 16, 1934 (M. and H. James); La Jolla (San Diego County), June 25, 1934 (M. and H. James); one labeled only Southern California. Recorded from flowers of *Rhamnus crocea* and *Salvia mellifera*.

Arizona.—Chiricahua Mountains, June 27, 1934 (Fowler).

Colorado.—Glenwood Springs, July 22–29, 1919, 5800 feet elevation, 39° 33' N., 107° 20' W. (H. F. Schwarz).

Both sexes differ from *C. nanula* Cockerell chiefly by the green coloration. I have never seen a Rocky Mountain *nanula* female with the clypeal mark greatly reduced; *rigdenae*, however, frequently has the clypeal mark reduced. The males also show some differences in face markings (see key). The Arizona specimens are a little more coarsely punctate than the others, but the difference is completely bridged by Californian specimens. Possibly at some time an Arizona race may be separated, but this is not advisable without much more material. Named for my mother, who first interested me in natural science.

#### ***Ceratina neomexicana* Cockerell**

##### **Figure 15**

Colorado.—Many from Boulder and White Rocks, Gregory Canyon, Boulder Canyon, and Jim Creak, near Boulder, recorded from flowers of *Potentilla*, *Hydrophyllum fendleri*, *Astragalus goniatius*, *Viola nuttalli*, *Nothocalis cuspidata*, and *Pentstemon*, from May 22 to July 3 (Lutz, W. P. Cockerell, and M. D. and M. M. Ellis); Elbert, June 9–11, 1922, elevation 7400 feet, at *Mertensia* (F. E. Lutz); Hubbard Ranch, near Elbert, June 9 (Figgins); Mesa Verde, July 3–7, 1919, elevation 7900 feet, about 37° 19' N., 108° 25' W. (F. E. Lutz); Florissant, June 14, 1908, on sand (Rohwer); Colorado Springs, April 20, on Willow (*Salix*); Colorado City, May 10, 1904, on *Erigeron canus* (T. D. A. and W. P. Cockerell); Starkville, June 13, 1919, 6800 feet elevation, 37° 6' N., 104° 30' W. (F. E. Lutz); Ridgeway, July 10, 1919, 7000 feet elevation, 38° 9' N., 107° 45' W. (F. E. Lutz); Minnehaha, June 17, 1922, on *Pentstemon gracilis*.

Utah.—Ogden, July 29–30, 1916.

Idaho.—Montpelier, July 6, 1920, 6100 feet elevation, 42° 19' N., 111° 18' W. (F. E. Lutz); Paris, July 8, 1920, 6000 feet elevation, 42° 14' N., 111° 25' W. (F. E. Lutz).

California.—Arroyo Seco Canyon, Pasadena, Los Angeles County, June 17, 1909 (F. Grinnell, Jr.).

This California specimen represents a great extension of range, but I can find no characters upon which to separate it from the Rocky Mountain specimens. The pleura are a little more coarsely punctate than in most specimens, but intergrades are found in Colorado material. This is the specimen recorded as *nanula* by Cockerell in 1910. It certainly seems to be large enough for *neomexicana*, but perhaps it is an unusually large *C. nanula rigdenae*. It is rather coarsely punctate for that, however.

The profile of the sixth tergite of the female is largely concave. The male has the process of the seventh sternite a little shorter and broader than in H. S. Smith's figure of *C. nanula*, but of the same type. For this reason it does not run well in Smith's key.

### *Ceratina punctigena* (Cockerell)

Figures 4, 5, 6, 10, 14

*C. neomexicana punctigena* COCKERELL, 1916.

MALE.—Similar to female. Apex of abdomen much as in H. S. Smith's figure of *C. nanula* or *metallica*. Clypeus with the usual trifoliate pale mark, the arms of about equal length, the lateral ones rather narrow and parallel sided; labrum with a pale area. Cheeks more strongly punctured than in female, not angulate. Hind femora with an inconspicuous obtuse angle (considerably greater than 125°) on under side.

FEMALE.—Sixth tergite convex in profile, with a small deep concavity in the last third. Cheeks variably toothed or angled below. One from same nest as specimens such as that shown in Fig. 4 has unarmed cheeks, but the punctation shows it to be *punctigena*, not *subpunctigena*, new species. This is the only specimen that I have seen which does not have distinctly angled cheeks. Individuals with large cheek teeth, such as that shown in Fig. 5, are usually large specimens, with rather finely punctate cheeks (though not as finely punctate as in *subpunctigena*).

California.—Altadena, Eagle Rock Hills, mouth of San Antonio Canyon, La Crescenta, Pasadena, and San Gabriel Canyon, all in Los Angeles County, from March 3 to June 26, on yellow *Cruciferae*, *Salvia mellifera*, *Paeonia brownii*, *Helianthus*, and almond (Michener); two of each sex removed from nest in twig on December 20, 1933, in the Eagle Rock Hills (Michener); Riverside, March 16, 1925, on *Scrophularia californica* (Timberlake, Coll.); Pine Valley (San Diego

County), June 16, 1934 (M. and H. James); Tejon, July 23, 1934 (M. and H. James).

*Ceratina subpunctigena*, new species

**FEMALE** (type).—Length, 9–11 mm.; bluish; clypeus entirely dark or with a much reduced pale line. Clypeus impunctate in the middle, with a few coarse punctures around the edges; rest of head rather coarsely punctate except for the front, which is largely impunctate; cheeks not toothed, very finely punctate below, where the impunctate band near the eye margin is usually widened. Eyes slightly divergent below. Scutum finely punctate in front, more coarsely so at the sides and behind, the disk posteriorly impunctate; scutellum rather finely punctate, quite sparsely so in the middle; postscutellum finely and closely punctured; posterior face and sides of propodeum punctate like the postscutellum; pleura coarsely punctate, not as coarsely so as in *C. sequoiae*, with a small impunctate spot near upper posterior corner, but anteriorly with punctures nearly as close as they can be. Tubercles pale; bases of anterior and posterior tibiae with small pale spots. First tergite impunctate except posteriorly; remaining segments rather finely and sparsely punctate except for the apical ones, which are more closely and coarsely punctate; profile of sixth tergite convex, with a rather small concavity near apex. Wings rather dark grayish, but not as dark as in *sequoiae*, the veins and stigma black; tegulae and under side of flagellum dark brown.

**MALE**.—Length, 8–9 mm.; similar to female except for the usual sexual characters. Process of seventh tergite slightly shorter than in Smith's figure of *nanula*. Angle on under side of hind femur more conspicuous than in *punctigena*, the apex dull when viewed from toward either end of femur. Median projection of clypeal mark shorter than laterals.

California.—Two from Crystal Lake, San Gabriel Mountains (Los Angeles County) (type locality), on *Verbena prostrata*, July 7, 1934 (Michener); Idyllwild (San Jacinto Mountains), June 24, on *Cirsium* (Cockerell); Dutch Flat (San Jacinto Mountains), on *Stachys*, August 31, 1934 (Michener); Pine Flat (San Diego County), June 16, 1934 (M. and H. James), one labeled only southern California.

This is apparently a Transition zone species, while *C. punctigena* is typically a species of Upper Sonoran.

The female is similar to *punctigena* but has less yellow on the clypeus, differently sculptured cheeks, no cheek angles, slightly larger concavity on sixth tergite, and average size larger. I give a rather full description because none has been published for *C. punctigena*. The male is similar to *C. neomexicana* Cockerell but larger, bluer, under side of flagellum dark brown (pale brown in *neomexicana*). Differs from *C. punctigena* by slightly broader process of seventh tergite, larger and sharper tooth on under side of hind femur, slightly wider lateral extensions and shorter upper extension of clypeal mark, and larger size.

*Ceratina utahensis*, new species

## Figure 7

FEMALE.—Length, about 7.5 mm.; similar to *C. subpunctigena*, having only a minute inconspicuous pale spot on clypeus. Cheeks finely punctate below, but impunctate band next to eye margin narrow. Pleura shining, not as coarsely punctate as in *subpunctigena*, the punctures of anterior part below tubercle being separated by about half their diameters (in *punctigena* and *subpunctigena* they are hardly separated). Eyes slightly converging below. Sixth tergite strongly convex above, with a moderate sized concavity apically. Wings dark reddish brown as in *sequoiae*, nearly as dark as in *melanoptera*; head and thorax a little greener than in *subpunctigena*. Also similar to *C. neomexicana* but abdomen bluer, wings darker, face slightly longer, profile of sixth tergite different (see figures).

Utah.—One from Ogden, July 25, 1920, 4300 feet elevation, 41° 15' N., 110° 59' W. (Mrs. F. E. Lutz).

*Ceratina gigantea* H. S. Smith

## Figure 16

MALE.—Length, 6-8 mm.; similar to the female. Clypeal mark with lobes of about equal length, the lateral ones wide at base, tapering to apex; labrum with a yellow area. Cheeks strongly punctate. Clypeus not low as in the female. Eyes strongly convergent below. Process of seventh tergite as in Smith's figure of *C. nanula* but a little shorter. Angle on under side of hind femur obtuse, conspicuous, and sharper than in *punctigena*, its apex not rounded.

FEMALE.—Apical two-thirds or three-fourths of sixth tergite concave, seen in profile.

California.—A pair, apparently in copulation, from Pasadena (Michener); Altadena, mouth of San Antonio Canyon, both in Los Angeles County (Michener). Dates range from March 3 to April 29. Flower records are *Helianthus*, almond, *Salix*, and *Ceanothus crassifolius*.

*Ceratina tejonensis* Cresson

## Figure 12

California.—Pasadena (Michener); Altadena, March 3, 1934, on *Paeonia brownii* (Michener, Coll.); Pasadena, May 31, 1919 (F. Grinnell, Jr.); San Gabriel Mountains, 3000 feet elevation, June 16, 1909 (F. Grinnell, Jr.); Claremont (Baker).

The male agrees with Cockerell's note (1925). One female is 10 mm. long, but agrees otherwise with Cockerell's notes (1910). Sixth tergite of female concave in profile except at base; punctures of pleura not so large that they meet.



*Ceratina acantha* Provancher

## Figure 13

Washington.—†Olympia and †Seattle.

Utah.—Ogden, August 29–30, 1916.

California.—†Niles Canyon, Alameda County, May 23, 1917 (W. M. Giffard); †San Mateo County, May 4, 1917 (F. Muir, W. M. Giffard); Santa Clara County, July 10 (W. M. Giffard); Guernville, Sonoma County, May 31, 1910 (Van Dyke); \*Pasadena; \*Altadena; \*Crystal Lake, San Gabriel Mountains; \*Eagle Rock Hills; Puddingstone Canyon, San Jose Hills; \*San Gabriel Canyon; \*mouth of San Antonio Canyon, Los Angeles County; \*Mill Creek, San Bernardino Mountains; \*Encinitas (San Diego County), June 28 (Cockerell). (Specimens from California localities for which no collector is given were collected by the author. The dates of these range from March 3 to December 4 but records are few after September. Specimens may be found in nests throughout the winter.)

In the above list localities marked with a \* are for typical *acantha*, those marked by a † are for *acantha submaritima*, while unmarked ones are doubtful.

This species can apparently be divided into two subspecies, differentiated by an average of characters of many individuals. The northern subspecies has been named *submaritima* Cockerell (*C. submaritima* Cockerell, 1897). It extends south well into California. Unfortunately, the single Utah female is not sufficient to establish its subspecific identity. It is worth while to record, however, that it has no pale mark on the clypeus. Among the specimens that I have seen, the most melanic (that is, the most extreme *submaritima*) are from coastal central California. Nine females from San Mateo and Alameda Counties all lack yellow on the clypeus, while ten males all have the upper lobe of the clypeal mark reduced or entirely wanting. All these specimens, including those from Washington State, are structurally alike, having, in the male, the process of the seventh tergite not quite so slender as in H. S. Smith's figure. The distinguishing characters of the two subspecies will be found in the key.

In Pasadena I have reared females both with and without a pale clypeal mark from the same nest. From the Pasadena region I have about seventy females but only two males (one from a nest with females)! This may be a local condition, as from Mill Creek two of my four specimens are males, I have a male from Olympia, and the specimens

recorded above as collected by Giffard, and Muir and Giffard are more than half males.

The male is distinguished from all other species found in this country by the acute angle of the hind femur. Profile of last tergite of the female largely concave.

#### KEY TO SPECIES

For convenience most of the known species of the subgenus *Zaodontomerus* found in the United States and northern Mexico have been included in the key. Notes on species not in the key are appended. The only other species of *Ceratina* found within this region are the small black ones (*arizonensis* Cockerell, Fig. 18, its form *vanduzeei* Cockerell, and *cockerelli* H. S. Smith (*lunata* H. S. Smith)) and a large species, apparently of a different group (*wagneri* Friese). Species marked by a \* are known to me only from the descriptions.

#### MALES

- 1.—Apex of seventh tergite ending in two small teeth.....\**diodonta* H. S. Smith.  
Apex of seventh tergite not ending in two teeth.....2.
- 2.—Hind femora expanded rather abruptly near the base, without a triangular projection near middle (Sandhouse, 1935); tubercles pale; projection of seventh tergite twice as wide as long.....\**dupla* Say.  
Hind femora with a ventral median tooth.....3.
- 3.—Projection of seventh tergite three times as wide as long; tubercles pale; bluish eastern species.....*calcarata* Robertson.  
Projection of apex of abdomen much narrower.....4.
- 4.—Fore tibiae with a longitudinal pale line; tubercles pale.....5.  
Fore tibiae with only a pale dot at base.....6.
- 5.—Wings fairly clear, pleura finely punctate.....*metallica* H. S. Smith.  
Wings very dark; pleura very coarsely but not very closely punctate.....*melanoptera* Cockerell.
- 6.—Tubercles dark.....7.  
Tubercles pale.....10.
- 7.—Rather small blue-green species with rather finely punctured pleura; angle of hind femur acute.....8.  
Rather small green species, probably similar to *acantha*; angle of hind femur acute.....\**acantha ehrhorni* (Cockerell).  
Larger blue species with conspicuous coarse punctures on pleura.....9.
- 8.—Arms of clypeal mark equal or nearly so.....*acantha* Provancher.  
Upper arm of clypeal mark shorter than the others, frequently wanting.....*acantha submaritima* (Cockerell).
- 9.—Angle on under side of hind femur obtuse.....*gigantea* H. S. Smith.  
Angle on under side of hind femur about a right angle.....*tejonensis* Cresson.
- 10.—Angle on under side of hind femur obtuse, considerably over 125°; large blue or blue-green species.....*punctigena* (Cockerell).

- Angle on under side of hind femur sharper, though obtuse, a little less than 125°.....11.
- 11.—Over 6 mm.; projection of seventh tergite usually wider than long.....12.
- Under 5 mm.; projection of seventh tergite usually as wide as long.....13.
- 12.—Smaller, greener; under side of flagellum light brown; apex of sixth tergite with an unusually dense brush of hair, giving the apex of abdomen, seen from above, a pointed appearance; projection of under side of hind femur not as in the next.....*neomexicana* Cockerell.
- Larger, bluer; under side of flagellum dark brown; projection of under side of hind femur rounded at apex when viewed from toward either end of femur.  
*subpunctigena* Michener.
- 13.—Blue; upper arm of clypeal mark distinctly longer than laterals.  
*nanula* Cockerell.
- Blue-green; upper arm of clypeal mark equal to or hardly longer than laterals.  
*nanula rigdenae* Michener.

## FEMALES

- 1.—Tubercles dark; bluish or bluish-green species.....2.
- Tubercles pale.....5.
- 2.—Smaller, less than 7 mm.; bluish green; pleura finely and rather sparsely punctate; eyes converging below.....3.
- Larger, 10 mm. or more; eyes diverging below; blue; pleura coarsely punctured, but shining ground showing between the punctures except sometimes anteriorly; clypeus low.....4.
- 3.—Clypeus without a pale mark, or the mark much reduced.  
*acantha submaritima* (Cockerell).
- Clypeus frequently with a pale mark.....*acantha* Provancher.
- 4.—Upper part of cheeks very finely and sparsely punctate, the punctures behind top of eyes separated by much more than their diameters.  
*gigantea* H. S. Smith.
- Upper part of cheeks more coarsely and closely punctate, the punctures behind top of eyes separated by about their diameters or less....*tejonensis* Cresson.
- 5.—Pleura coarsely punctate, the punctures, anteriorly at least, as close as they can be, or at least many of them meeting; size rather large.....6.
- Pleura more finely punctate, showing shining ground between the punctures..9.
- 6.—Blue to bluish-green species.....7.
- Green species (the greenest of any recorded in this paper); inner orbits divergent in large specimens, parallel in small ones (see also *neomexicana*, which is sometimes green).....*sequoiae* Michener.
- 7.—Apical tergite largely concave in profile; inner orbits usually parallel.  
*neomexicana* Cockerell.
- Sixth tergite convex except for a small deep concavity near apex.....8.
- 8.—Clypeus dark or with a reduced yellow mark; cheeks finely and sparsely punctate below, the impunctate band next to eye margin usually widened below; cheeks not toothed.....*subpunctigena* Michener.
- Clypeus with a yellow bar; cheeks more coarsely and closely punctate below, the impunctate band next to the eye margin narrow except in a few large individuals; cheeks almost always toothed or angled below.  
*punctigena* (Cockerell).

- 9.—Legs brown; small bluish eastern species.....*metallica* H. S. Smith.  
 Legs black or metallic, except for the tarsi which may be brown.....10.
- 10.—Impunctate, usually blackish, area of scutum restricted, not extending beyond the parapsidal grooves, and partly divided medianly by a longitudinal green punctured area; eastern.....*dupla* Say and *calcarata* Robertson.  
 Impunctate blackish area of scutum larger, extending beyond the parapsidal grooves, though they may be margined by a row of punctures on each side, and not so much divided medianly; western.....11.
- 11.—Abdomen blue; eyes converging below.....12.  
 Abdomen, and rest of body, blue-green or green.....13.
- 12.—Length, 7.5 mm.; head and thorax blue-green; wings dark.  
*utahensis* Michener.  
 Length, 6 mm. or less; head and thorax blue; wings pale....*nanula* Cockerell.
- 13.—Length, 7 mm. or more.....*neomezicana* Cockerell.  
 Length, less than 7 mm., usually considerably less, but average size a little larger than *nanula*.....*nanula rigdenae* Michener.

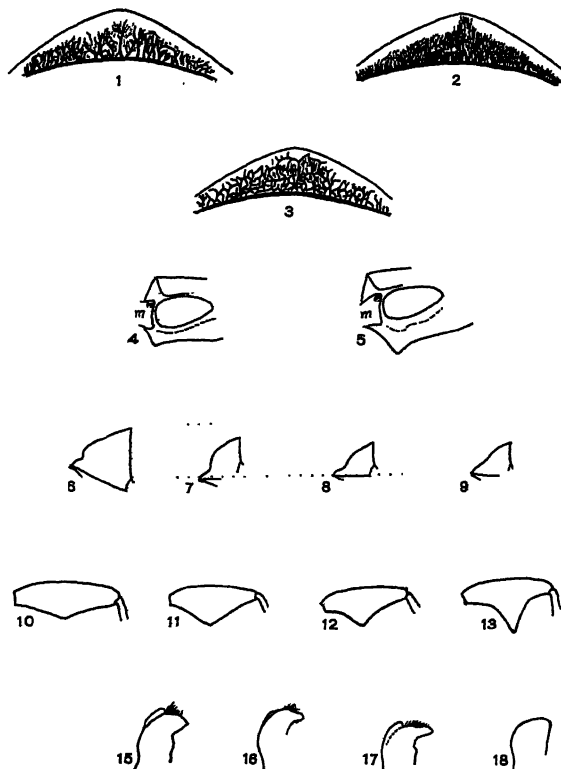
\**C. strenua* F. Smith from Texas has, in the male, reddish anterior tibiae with a light stripe on outer side. It should differ from *metallica* H. S. Smith by the rounded apex of the abdomen. However, I suspect that *metallica* is a synonym of *strenua*. Possibly I have never seen female *metallica*, but one from Maryland ought to be that form. I cannot distinguish it from Texas examples which seem to be *strenua*.

\**C. pacifica* H. S. Smith (female) has a large impunctate area on the upper part of the pleura; cheeks evidently toothed after the manner of *punctigena*.

\**C. melanoptera* Cockerell (female) has very dark wings. It is bluer than *sequoiae* and more coarsely punctate than *utahensis*.

\**C. diodontia* H. S. Smith (female) is similar to *nanula*, but more brassy green, punctures of face broader, etc.

*C. dupla* Say and *C. calcarata* Robertson. I am unable to distinguish these species in the female. I have not been able to separate them by Sandhouse's key (1935), as single individuals were found to have a combination of the characters of the two species, as tabulated by Sandhouse. While on the subject of these species, I may say that certain western records of *dupla* are apparently erroneous. At least one Colorado specimen recorded as *dupla* is really *neomezicana*. I strongly suspect that all western records of both of these species are incorrect.



Figs. 1, 2, and 3. Enclosure of propodeum of *Ceratina nanula rigdenae* Michener, female.

Fig. 4. Side of head of *Ceratina punctigena* (Cockerell), type female. *m* is the mandible. Dotted line indicates edge of impunctate band near eye margin.

Fig. 5. Side of head of *Ceratina punctigena* (Cockerell), female. Explanation as for Figure 4.

Fig. 6. Lateral view of apex of abdomen of *Ceratina punctigena* (Cockerell), female.

Fig. 7. Lateral view of apex of abdomen of *Ceratina utahensis* Michener, female.

Fig. 8. Lateral view of apex of abdomen of *Ceratina sequoiae* Michener, female.

Fig. 9. Lateral view of apex of abdomen of *Ceratina nanula* Cockerell, female.

Fig. 10. Hind femur of *Ceratina punctigena* (Cockerell), male.

Fig. 11. Hind femur of *Ceratina nanula* Cockerell, male.

Fig. 12. Hind femur of *Ceratina tejonensis* Cresson, male.

Fig. 13. Hind femur of *Ceratina acantha* Provancher, male.

Fig. 14. Apical part of stipes of *Ceratina punctigena* (Cockerell).

Fig. 15. Apical part of stipes of *Ceratina neomexicana* Cockerell.

Fig. 16. Apical part of stipes of *Ceratina gigantea* H. S. Smith.

Fig. 17. Apical part of stipes of *Ceratina nanula* Cockerell.

Fig. 18. Apical part of stipes of *Ceratina arizonensis* Cockerell.

## APPENDIX

While on the subject of *Ceratina*, I wish to record some localities for *C. arizonensis* Cockerell (Fig. 18), the only Californian species not belonging to *Zaodontomerus*.

California.—Altadena, Eagle Rock, Pasadena, San Gabriel Canyon, mouth of San Antonio Canyon, and La Crescenta, all in Los Angeles County; Murrieta; Corona. Dates range from March 3 to December 4. From August to March they are uncommon, though I have records for September, October, November, and December. Specimens were taken from *Rhamnus crocea*, *Heliotropium curassavicum*, *Stephanomeria*, *Eriogonum fasciculatum*, *E. gracile*, *Phacelia tanacetifolia*, *Ceanothus crassifolius*, *Baccharis*, *Salix*, *Lotus*, and *Stellaria media* (all Michener, Coll.).

This is one of the most common bees in southern California, but it has not adapted itself to cultivated plants as has *Ceratina acantha* Provancher, the latter being, except for *Halictus meliloti* Cockerell, the most common bee on cultivated flowers in Pasadena. *C. arizonensis* nests in twigs, as do other species of the genus. I have included a figure of a stipes of this species, to show how different it is from the *Zaodontomerus* group.



# AMERICAN MUSEUM NOVITATES

Number 845

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

April 29, 1936

## A NEW GENUS AND SPECIES OF FULGORID FROM HAITI (HOMOPTERA: FULGORIDAE)

By HERBERT L. DOZIER

The new genus and species described in the present paper represents a very interesting addition to the West Indian fauna, collected by the

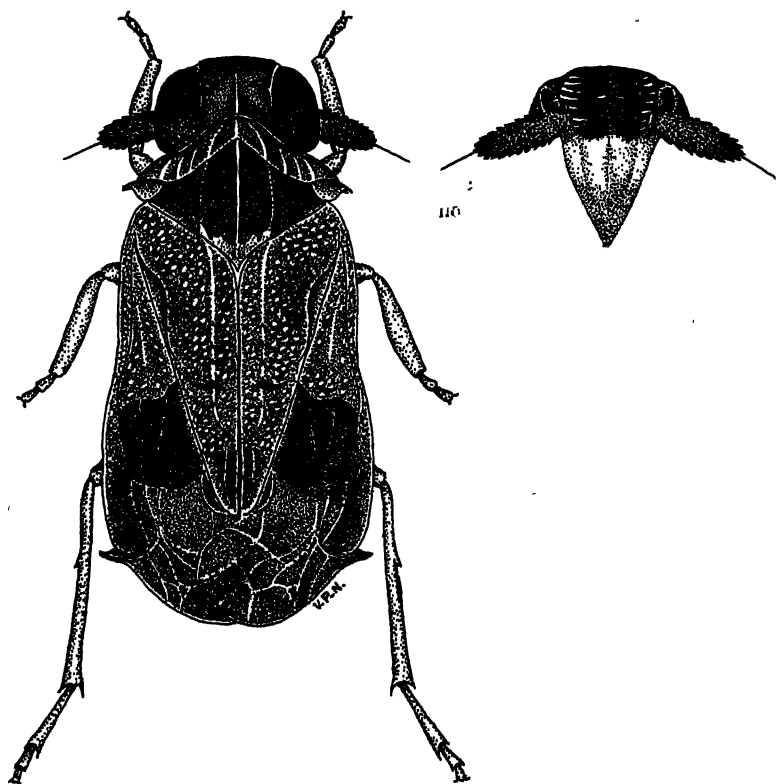


Fig. 1. Dorsal view and frons of *Haitiana nigrita* Dozier

writer while serving as entomologist for the Service Technique de l'Agriculture, Port-au-Prince, Haiti. The drawing illustrating it was carefully made by Louis Pierre-Noel of the Service Technique.



The type and a paratype are deposited in The American Museum of Natural History and a paratype each in the collections of the U. S. National Museum and the writer.

### Subfamily Cixiinae

#### HAITIANA, NEW GENUS

Head short and broad, the eyes prominent. Antennae conspicuously large and flattened, with distal bristle. Pronotum short, angularly emarginate behind, distinctly carinate. Scutellum tricarinate. Elytra short and compact, somewhat leathery in appearance, distinctly overlapping at their apices, and with a very prominent, salient, sharp lateral fold at the margin of each toward the apex.

GENOTYPE.—*Haitiana nigrita* Dozier.

#### *Haitiana nigrita*, new species

A small, inconspicuous but very distinctly marked species that could easily be mistaken for a delphacid unless closely examined.

General color dark brown; the eyes, antennae, scutellum, and mid-area of the elytra, black; frons black, with variable short, white linear markings on each side, and a short transverse white line on the disk, interrupted at its middle; clypeus with basal half white, the remaining apical part testaceous. Vertex testaceous brown, mottled along margins with fuscous; pronotum testaceous brown, the three small lateral carinae distinctly whitish; scutellum black, the apex and the median carina, pale. Elytra brown, very conspicuously covered with white raised granules, the non-granulated areas marked with shiny black; a small reddish area present on each side near the apical wing fold.

Broadest across the elytra toward the apex. Head rather broad and short, the eyes prominent; antennae wide, distinctly flattened, with terminal bristle. Frons faintly carinate, the clypeus strongly so. The median ocellus present but very difficult to differentiate. Pronotum very short, angularly emarginate behind, with median carina and adjacent lateral carinae less distinct than the three white lateral ones. Scutellum tricarinate. Elytra short and compact, coriaceous, the clavus sharply differentiated, conspicuously granulated, with the lateral margins undulated. Elytra distinctly overlapping at their apices, a very prominent, salient, lateral fold at the margin of each toward the apex. Hind tibiae with a single, short, inconspicuous spine.

Length of body, 2.75 mm.; length to tip of elytra, 4 mm.; greatest width, 1.5 mm.

Described from three specimens taken by the writer sweeping grass and low shrubbery amongst trees in dry pasture at Hinche, Haiti, June 24, 1930, and a fourth specimen from same place May 14, 1931.





## RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 9.

A NEW RACE OF *HYOSCIURUS*

By G. H. H. TATE AND RICHARD ARCHBOLD

*Hyosciurus heinrichi* ileile, new subspecies

TYPE.—No. 101308, Amer. Mus. Nat. Hist.; ad. ♀; Ile-ile, North Celebes, 1700 meters; Nov. 12, 1930; collector G. Heinrich (field No. 130; Buitensorg Mus. No. 2763). Skin and skull in good condition.

GENERAL CHARACTERS.—Differing from *H. heinrichi* in its ventral markings which are pale yellowish white instead of white and rather smoothly margined instead of highly irregular in outline.

Skull with shorter rostrum than in *H. heinrichi*,<sup>1</sup> and with  $p^4$  a mere spicule;  $m^1$  definitely smaller than  $m^1$  of *H. heinrichi*. Pterygoid fossa definitely narrower than in *heinrichi*.

The form is based upon the type and a female paratype (Buitensorg 2762, Heinrich 128).

MEASUREMENTS.—See table (*loc. cit.*, p. 6).

That this race was not earlier distinguished is due to the fact that A.M. No. 101311 (Buitensorg Mus. No. 2596) was believed to come from Ile-ile, thus creating the impression of a single variable species rather than of two well-marked forms. With correction of the above point, it will be seen that the molar teeth figured (*loc. cit.*, p. 3, Figs. 5 and 6) are those, respectively, of *H. h. ileile* and *H. h. heinrichi*. The discovery of the distinctness of these races is fully in keeping with the differences to be noted between representatives of many other genera occurring in Celebes.

<sup>1</sup> See Archbold and Tate, 1935, Amer. Mus. Novitates, No. 801, p. 6.



# AMERICAN MUSEUM NOVITATES

Number 847

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

April 30, 1936

## AFRICAN HYLAEINE BEES

BY T. D. A. COCKERELL

The bees recorded below are those from the Cockerell-Mackie-Ogilvie Expedition of 1931-1932 (except those already reported in Ann. Mag. Nat. Hist., Aug., 1932), and a series received from Dr. J. Bequaert. The holotypes will be found in The American Museum of Natural History. I have followed Bridwell (Proc. Hawaiian Ent. Soc., June, 1919) in recognizing the genera *Nothylaeus* and *Metylaeus*. It also seems correct to place the African *Hylaeus* (south of the Sahara) in a distinct subgenus *Deranchylaeus* Bridwell. Certainly they form a group apart from those of other regions.

I have been somewhat in doubt as to whether the name *Prosopis* should not be preferred to *Hylaeus*. Technically, *Hylaeus* is valid, and to save *Prosopis* it would have to be made a nomen conservandum. This does not seem imperative, since Foerster's great Monograph (1871) uses *Hylaeus*, and Meade-Waldo, in the 'Genera Insectorum' (1923) does the same. Hence it cannot be claimed that *Prosopis* has been in universal use.

### *Hylaeus abjunctus*, new species

MALE.—Length about 5 mm., anterior wing 4; black, moderately robust; face below antennae white (a faintly brownish white); supraclypeal mark short and transverse, the upper margin irregular; lateral face-marks ending on inner side at level of top of clypeus, rapidly narrowing to orbits, the upper portion slender; labrum and mandibles black; scape strongly swollen apically, pyriform (as Alfken describes for male *H. atriceps*, the description believed by Bridwell to be based on *H. curvicastratus*); flagellum red beneath; three delicate well-separated frontal keels; thorax wholly black; collar without a distinct band; mesothorax moderately shining, distinctly punctured, the punctures easily visible under a lens; scutellum shining, well punctured; area of metathorax minutely and densely covered with vermiform rugae, opaque as seen with a lens; tegulae dark brown, with a small light spot in front; wings hyaline, very faintly brownish apically; stigma reddish brown; nervures brown; first recurrent nervure a considerable distance from end of first cubital cell, second very near end of second cubital; legs black, the front tibiae with a broad pale stripe, hind tibiae all black, basitarsi largely white, small joints of tarsi dark; abdomen without hair-bands; first tergite closely and very distinctly punctured; venter unmodified.

Cape Town, April 4, 1920 (Michael Bequaert). Allied to the group of *H. curvicaarinatus*, but easily known by the black hind tibiae, and other characters.

***Hylaeus absonulus*, new species**

MALE.—Length about 5 mm.; black, rather robust, the first tergite swollen and transverse; face below antennae creamy white; the supraclypeal mark rather small, triangular, with the upper end obtuse, projecting very little above level of inner side of lateral marks; lateral face-marks rapidly narrowing above, ending on orbit, the margin of the light area of face above evenly rounded, a section of a circle; labrum and mandibles black; scape black, very broad at end; flagellum red beneath; mesothorax and scutellum very finely punctured, the punctures scarcely visible under a lens; area of metathorax with irregular moniliform rugae; tegulae with a light spot; wings dusky hyaline, stigma dark, nervures brown; first recurrent nervure joining first cubital cell a short distance from end, second a short distance from end of second cubital; femora black; front tibiae pale, almost white, in front light red on inner side; middle tibiae black, with a small white spot at base; hind tibiae broadly white at base; tarsi white, becoming rufous apically; abdomen stout, first tergite very finely punctured; traces of a slender hair-band at sides of first tergite, but none on the others; sternites not modified.

Cape Province: George, Nov. 4–7, 1931 (J. Ogilvie). Close to *H. tenuis dominiae*, but considerably more robust, with broader face. The clypeus is very high and narrow. The frontal carinae are widely separated below.

***Hylaeus bequaertianus* Bridwell**

Liberia: Du River, Camp No. 3 (J. Bequaert). One of each sex, the male with face-marks very pale yellow, the female with long pale lines along inner orbits.

Belgian Congo: Faradje, 29° 40' E., 3° 40' N. (J. Bequaert). Male, face-marks dull white. These agree with the supposed *H. ogilviei* Cockerell, which I recorded from near the Cassai River, Angola. A topotype male of *H. ogilviei* from Tshibinda has the lateral marks above with a narrower, finger-like, lobe. The female *H. ogilviei* lacks the stripes along inner orbits. *H. bequaertianus* was described from Nigeria. The males before me have darker tibiae (as in *H. ogilviei*) but must surely belong to the same species. It may be necessary to treat *H. ogilviei* as a high altitude subspecies of *H. bequaertianus*.

***Hylaeus graaffi*, new species**

MALE.—At first appearing very near *H. sanctus*, but definitely distinct by the following characters: rather larger, with broader face; supraclypeal mark higher than broad; clypeus broader, its upper margin very little shorter than the width of a lateral mark at same level; flagellum conspicuously longer; tegulae with a large light spot;

abdomen much more robust, first tergite cup-shaped, strongly punctured (as seen under lens); second tergite strongly punctured, with the broad apical part shining, excessively minutely punctured (this at once separates it from *H. alfkeni*). Other characters are: face-marks very pale yellow; face strongly punctured; mandibles black, with the sharply bidentate end rufescent; labrum black, with long hairs; scape black, hardly swollen; flagellum very bright red beneath; frontal keels well separated, subparallel, slightly bent in middle; tubercles black; collar with a slender, inconspicuous line of whitish hair; mesothorax and scutellum strongly punctured; area of metathorax with fine plicae and two transverse keels, beyond the second keel is an irregularly sculptured area, and beyond this a minutely pitted space; wings quite clear, stigma and nervures very dark; first recurrent nervure joining first cubital cell a little before end, second meeting intercubitus; anterior tibiae light red in front, tarsi light red, with the basitarsi cream color; hind tibiae broadly white at base; suture between first and second tergites impressed; no abdominal bands. The inner margin of upward extension of lateral marks is very irregular, whereas in *H. vau* it is perfectly straight and even. *H. vau* has a shorter face, and the second tergite has a short, channel-like, apical depression, which is well defined right across.

Cape Province: Graaff-Reinet, October, 1931 (J. Ogilvie). Named after Colonel van DeGraaff, who founded Graaff-Reinet.

#### *Hylaeus immarginatus* (Alfken)

Cape Town, April 4, 1920, two females (Michael Bequaert). In one, the minute spot on apical part of clypeus is lacking. Alfken describes only the female, but Bridwell has described the male, which he collected at Cape Town. I have before me a male with the same data as the females, and also one from Mitchell's Pass, Ceres, Cape Province, Feb., 1932 (L. Ogilvie). The male has no supraclypeal mark, and the upper end of inner side of lateral marks does not go above level of top of clypeus; the first tergite is closely punctured.

#### *Hylaeus isochromus*, new species

MALE (type).—Length about 6 mm.; black, slender, with long narrow abdomen; head circular seen from in front, face rather broad for a male; labrum and mandibles clear red; face-marks cream color, including clypeus (which has a black line down each side, and also between its upper edge and supraclypeal mark), rather short supraclypeal mark with sloping sides, and narrow lateral face-marks, which are broadened at level of lower part of supraclypeal mark, but extend narrowly along orbits above level of antennae; antennae long, red, the flagellum dusky above; collar with a very slender whitish hair-band; tubercles margined with pale yellowish; mesothorax dull, very strongly punctured; scutellum with similar punctures, but more shining; area of metathorax dull and rugose; tegulae with a small light spot; wings brownish hyaline, darkest apically; stigma very dark, appearing black, nervures dark; first recurrent nervure ending some distance from end of first cubital cell, second at extreme apical corner of second cubital; legs dusky red, hind tibiae with a light spot at base, or hind tibiae may be nearly black throughout; abdomen shining, suture be-



tween first and second tergites impressed; a conspicuous patch of white hair at sides of margin of first tergite; punctures of abdomen excessively minute; apex showing a pair of little spines. In the other male the upper end of clypeus, and stripes part way down margin, are pale red.

**FEMALE.**—More robust, length about 6.4 mm.; legs black, the tarsi somewhat brownish, anterior tibiae bright red in front; second tergite as well as first with conspicuous white hair at sides. The labrum and mandibles are red; face reddish orange (probably reddened by cyanide to some extent), with no dark margins to clypeus; supraclypeal mark larger and higher, subquadrate.

**Liberia:** Memeh Town, Aug. 25–29, 1926, two males and a female (J. Bequaert). Peculiar for the similarly colored faces of the two sexes. By the scape being red in front, it is easily separated from *H. rhodognathus*.

#### ***Hylaeus kasindensis*, new species**

**MALE.**—Length about 5 mm.; very slender, black, the first abdominal segment, however, cup-shaped, with broad shoulders; head seen from in front subtriangular in outline; labrum and mandibles red, but the distinct malar space shining black; face below antennae yellow (reddened by cyanide in type); supraclypeal mark small and transverse, not going above level of inner side of lateral marks; lateral marks narrowing to a point on orbit a little above level of antennae; scape short, black, moderately swollen; flagellum long, bright red beneath; collar with a very slender hair-band, not conspicuous; tubercles black; mesothorax dull, scutellum more shining, both strongly punctured for such a small insect; area of metathorax with strong rugae, producing a cancellate effect; tegulae with a light spot; wings hyaline, faintly dusky; stigma large, dark brown, nervures pale; second cubital cell broad above; recurrent nervures received near the corners of cubital cells; legs black, with yellowish-white tarsi, the anterior tibiae pale in front (in the cotype the tarsi are pale red, with the hind basitarsi white); abdomen very slender, dark brownish or brownish black, excessively finely punctured, and without hair-bands or patches.

**Belgian Congo:** Kasindi to Beni, 29° 30' E., 0° 30' N., Aug., 1914, two males (J. Bequaert). Closely allied to *H. rhodognathus*; distinguished by the brownish abdomen, and short supraclypeal mark.

#### ***Hylaeus perater*, new species**

**FEMALE (type).**—Length, 6 mm., anterior wing 4; black, without light markings anywhere; flagellum entirely black (in Vumba specimen brownish beneath); clypeus dull, with weak punctures and no fovea; frontal keels well separated, strongly angulate in middle (style of *H. melanosoma*); collar with a very thin grayish-white hair-band; mesothorax dullish, strongly punctured, the median groove distinct, and running its whole length; scutellum convex, strongly punctured, shining anteriorly; area of metathorax dull and rugose; tegulae small and black; wings strongly brownish, stigma and nervures dark; basal nervure meeting nervulus in type (but in the other Tshibinda specimen, and the Vumba one, falling considerably short of it); first recurrent nervure some distance from end of first cubital cell, second ending at apical corner of second cubital; abdomen shining, rather broad, with a very faint

greenish tinge; first and second tergites with slender white hair-bands at sides; first tergite excessively minutely punctured.

MALE.—Similar but less robust, with narrower face (orbits strongly converging below); long black antennae; the scape swollen, almost globular, shining; clypeus longitudinally depressed in middle, in a strong side light appearing to have two obtuse longitudinal ridges; face and legs entirely black.

Belgian Congo: Tshibinda (type locality), two females, Aug. 27, 1931 (Alice Mackie, J. Ogilvie).

Southern Rhodesia: Vumba, Umtali, one of each sex, May 23–26 (J. Ogilvie). Easily known from *H. melanosoma* by the dark antennae and more dusky wings; and the black-faced male is very unusual, suggesting the European *H. cornutus* (Smith).

### *Hylaeus perdensus*, new species

FEMALE.—Length about 5 mm., anterior wing 3.7; black, with no light marks on head or thorax, but flagellum bright red beneath; labrum not polished; clypeus dull, rather closely and strongly punctured on a minutely pitted surface; frontal keels very obtusely angled above the middle, and curved at upper end; collar with a slender line of white pubescence; mesothorax dull, very densely and coarsely punctured; scutellum shining, with separated punctures; area of metathorax irregularly plicatulate, much as in *H. sublucens*; tegulae with a large white spot, covering fully anterior half; wings hyaline, with a large dark reddish-brown stigma; first recurrent nervure joining first cubital cell some distance from end, second going to apical corner of second cubital; legs black, tarsi rufous at tips; abdomen dullish, with a sericeous surface, first tergite with well separated, very minute punctures, which do not occur on the second; margins of first tergites at sides with a fine line of white hair.

Southern Rhodesia: Matopo Hills, Oct. 1, 1931 (J. Ogilvie). Various black-faced females may be separated as follows:

1.—Flagellum dark, not red beneath (male also black-faced).....*perater* Cockerell.

Flagellum bright red beneath.....2.

2.—Collar with a distinct though slender light hair-band; face entirely black.....3.

Collar with no hair-band; inner orbits marked with a pale line or spot.....4.

3.—Mesothorax somewhat shining the punctures distinctly separated.

*sublucens* Cockerell.

Mesothorax entirely dull, very densely punctured.....*perdensus* Cockerell.

4.—Mesothorax more coarsely punctured, the punctures distinctly visible under a lens; a long pale line along inner orbits.....*bequaertianus* Bridwell.

Mesothorax very finely punctured; a punctiform light spot near inner orbits.

*punctiferus* Cockerell.

Compared with *H. melanosoma*, *H. perdensus* has a much narrower, more parallel-sided thorax, and is smaller. It is, however, larger than the very minute *H. atriceps* Friese, a female of which, from Shilouvane, Transvaal, was examined in the American Museum. *H. atriceps* has the flagellum red beneath except at base.

*Hylaeus promontorii* (Meade-Waldo)

Transvaal: Louis Trichardt, April 4-10, 1932, four males (J. Ogilvie). In these specimens the scape, instead of being all black, has a little red spot at end. This is *Prosopis longula* Friese, 1913. The name was preoccupied, and Meade-Waldo changed it to *H. promontorii*, an unfortunate designation for an insect described from Bulawayo, Southern Rhodesia.

*Hylaeus punctiferus*, new species

FEMALE.—Length about 5 mm.; robust, black, with no light marks on head or thorax except a very minute spot near inner orbit on each side; mandibles stout, bidentate; labrum with a median pit bounded by a ridge on each side; clypeus ordinary (with no fossa), microscopically lineolate, with scattered minute punctures; no suture between clypeus and supraclypeal area; frontal keels very obtusely angulate in middle; scape black, not swollen; flagellum bright red beneath; mesothorax and scutellum dull, closely punctured on a roughened surface; area of metathorax rather shining, with weak irregular plicae, crossed by a ridge very near base, and by another toward the apex, the triangular area beyond the second ridge densely covered with excessively minute punctures (only seen under microscope); tegulae black, sparsely punctured; wings hyaline, stigma black, nervures dark; recurrent nervures received equally distant from ends of first and second cubital cells; legs black; abdomen broad, shining, without hair-bands or patches; first tergite broad, with excessively minute scattered punctures on a microscopically lineolate surface.

Natal: Durban, Oct. 14-18, 1931 (J. Ogilvie). The face is narrower than in *H. melanosoma*. The finely punctured mesothorax distinguishes it from *H. bequaertianus*.

*Hylaeus redivivus*, new species

FEMALE.—Like *H. lightfooti* Bridwell, with the same deep shining pit on clypeus. I at first thought it was the same, but it is easily distinguished by the excessively finely and closely punctured first tergite, the pale grayish (not brownish) wings, and the entirely dull sides of metathorax. Face black, with very small pale marks near middle of anterior orbits; flagellum red beneath; tegulae with a light spot; posterior truncation of thorax not sharply defined at sides. In Bridwell's key it goes to *H. lightfooti*, except for the fine punctures of first tergite. In Friese's key it runs out, having collar and tubercles all black, and being less than 6 mm. long.

Natal: National Park, March 3-15, 1932 (A. Mackie, L. Ogilvie). Three specimens. A female from Lady Grey, Cape Province, Feb. 13, 1925, is somewhat smaller. It was from a series labelled *H. atriceps* Friese in the British Museum, but it is larger than that species, and has the characteristic clypeal pit. The type is from Natal. I have thought it possible that this might be the female of *H. tenuis dominae*, but I have no proof that this is the case.

*Hylaeus rhodognathus*, new species

MALE.—Length about 4.5 mm., anterior wings about 3; black, slender, with a long narrow abdomen, the first tergite broadly campanulate; head broad, but face rather narrow; labrum and mandibles bright red; face below antennae creamy white, the upper edge of the light color forming a section of a circle, interrupted by the projecting rounded upper end of supraclypeal mark; lateral marks ending acutely on orbital margin at about level of antennae; scape short and thick, entirely black; flagellum very long, reaching scutellum, brown above, bright red beneath; collar with a slender white fringe, tubercles black, tegulae with a large light spot; mesothorax closely punctured, coarsely for such a small insect, the three impressed lines on anterior part very distinct; scutellum shining and strongly punctured; suture between mesothorax and scutellum strongly depressed; area of metathorax shining, in strong contrast with the dull postscutellum; wings clear hyaline, with dark brown stigma, nervures brown; first recurrent nervure reaching extreme apical corner of first cubital cell, second meeting outer intercubitus; legs black, the front tibiae red with a yellowish stripe, the hind tibiae with a large white spot at base; tarsi light red, the hind basitarsi white on outer side; abdomen moderately shining, very finely punctured, without hair-bands; venter simple. There is a frontal groove, and the frontal keels between the antennae are well separated, strongly angulate about the middle, of the same general type as in *H. melanosoma* Cockerell.

Belgian Congo: south of Bukavu, Aug. 28, 1931 (L. Ogilvie). Resembles *H. curvicaarinatus* (Cameron), but has a much paler face, and red labrum and mandibles. The abdomen is longer and narrower.

*Hylaeus sanctus*, new species

MALE.—Length not quite 4 mm.; black, slender, with long narrow abdomen, the first segment campanulate; orbits strongly converging below; labrum, mandibles and tubercles black; face below antennae very pale yellow, the upper edge of the light color forming a small section of a circle, slightly interrupted by the protruding supraclypeal mark, which is about as broad as long, and rounded above; the lateral marks end acutely on orbital margin at about level of antennae; the upper margins of supraclypeal and lateral marks are irregular; scape black, pyriform; flagellum bright red beneath; frontal keels obtusely angulate in middle; mesothorax and scutellum with fine punctures, but rather coarse for such a small insect, those on mesothorax running more or less in rows; area of metathorax with delicate, regular, well-separated plicae, crossed by a ridge, the plicae more numerous above the ridge than below it; tegulae black; wings hyaline, faintly dusky, stigma dark brown, nervures brown; first recurrent nervure joining extreme apical corner of first cubital cell, second meeting intercubitus; legs black, the anterior tibiae rufous in front, hind tibiae with a small light spot at base, hind basitarsi white; abdomen without hair-bands or spots; first tergite (under a powerful binocular) shows a very minutely roughened surface, on which are widely scattered, excessively minute punctures.

Southern Rhodesia: Christmas Pass, Umtali, May 20–21, 1932 (Alice Mackie). I had to consider whether this could be a variety of *H. varians*, but the minute size and presence of a supraclypeal mark are sufficiently distinctive.

The following table compares this with a series of small males:

- 1.—Mandibles yellow; supraclypeal mark present, longer than broad; scape black, with a red spot at end.....*promontorii* Meade-Waldo.  
Mandibles red.....2.  
Mandibles black.....4.
- 2.—Scape red in front.....*isochromus* Cockerell.  
Scape entirely black.....3.
- 3.—Supraclypeal mark going conspicuously above inner sides of lateral marks; abdomen intense black.....*rhodognathus* Cockerell.  
Supraclypeal mark not going above inner sides of lateral marks; abdomen brown or brownish black; clypeus not so narrow as in *H. sanctus*, its upper margin not shorter than width of adjacent lateral marks at same level.  
*kasindensis* Cockerell.
- 4.—Supraclypeal mark present; clypeus very narrow above, its upper margin much shorter than width of an adjacent lateral mark at same level.  
*sanctus* Cockerell.  
Supraclypeal mark absent.....5.
- 5.—Upper end of lateral marks obtuse, curving away from orbits; scape black, swollen.....*bequaertianus* Bridwell.  
Upper end of lateral marks pointed, close to eye.....*varians* Cockerell.

#### *Hylaeus sublucens*, new species

FEMALE.—Length about 4.5 mm., anterior wing 3.5; black, moderately robust, with no light marks on head or thorax, but flagellum bright red beneath; mandibles stout; labrum smooth and highly polished; face broad, entirely dull, the clypeus sparsely punctured on a minutely lineolate and pitted surface; frontal keels widely separated, curved rather than angulate; mesothorax and scutellum finely punctured, the latter less densely, the surface moderately shining but not polished; median groove of mesothorax extending only half-way back, parapsidal grooves distinct; sides of postscutellum with erect finely plumose white hairs; area of metathorax with fine plicae, the plicate part separated by a transverse keel from the rugulose apical part; tegulae very dark brown; wings hyaline, with a large brown stigma; nervures reddish brown, the recurrenents joining apical corners of the cubital cells; collar with a slender but evident line of white hair; legs black; abdomen shining, without hair-bands or patches; first tergite without evident punctures.

Transvaal: Louis Trichardt, April 4–10, 1932 (Alice Mackie). Near to *H. melanosoma*, but smaller, with much narrower clypeus. The frontal keels in *H. melanosoma* are decidedly angulate in middle.

#### *Hylaeus tenuis* (Alfken) variety *dominae*, new variety

According to Bridwell (but with some measure of doubt), *H. tenuis* is to be regarded as a synonym of *H. curvicaarinatus* (Cameron). I have before me a male *H. curvicaarinatus*, with frontal keels exactly as described by Cameron and large light spot on tegulae, taken at Graaff-Reinet by Mrs. Ogilvie. This is about 35 miles from Pearston, the type locality of *H. curvicaarinatus*, and I feel sure it is that species. But the

male from Mossel Bay, received from the British Museum as *H. curvicarinatus*, is another species. It has entirely black tegulae, and the frontal keels are widely divergent, in the form of a broad V. This insect, collected by Turner, I will call *H. vau*, new species. These two agree in the coarsely punctured mesothorax, but I have another species, which I refer to *H. tenuis*, distinguished by the much more finely punctured mesothorax. The tegulae have small light spots, or none. This species comes from Lady Grey, Cape Province (R. J. Nel); males labelled *H. atriceps* (Friese), variety, and *H. robertianus* (Cameron), variety. Bridwell apparently had this as *H. curvicarinatus*; he expresses the opinion that *H. robertianus* is the same, and also *H. atriceps* as understood by Alfken and others, and *H. tenuis*, female, but perhaps not the male. The type locality of *H. tenuis* is Port Elizabeth, and the supraclypeal area is said to be black in the male. Bridwell states that bred series show that the supraclypeal mark is variable, and may be present or reduced to a narrow line along lower margin. My specimens, like Bridwell's, are fully 5 mm. long; Alfken says 4-4.25 mm. Thus there is a reasonable basis for regarding the Lady Grey form as a distinct variety (perhaps subspecies), and I name it variety *dominae*. The hair-bands at sides of tergites are weak and indistinct, contrary to Bridwell's account. The frontal keels are similar to those of *H. curvicarinatus*. The following table separates a number of very similar males, all having the supraclypeal mark present, and the scape and tubercles entirely black.

- 1.—Hind tibiae entirely black; face cream color; supraclypeal mark short, transverse; lateral face-marks slender above; scape greatly swollen, pyriform (Cape Town).....*abjunctus* Cockerell.  
Hind tibiae white at base; supraclypeal mark higher than broad; lateral face-marks broader above.....2.
- 2.—Mesothorax coarsely punctured.....3.  
Mesothorax very finely punctured.....4.
- 3.—Tegulae black; frontal keels widely diverging, close together at lower end; hind basitarsi white, with a red spot at extreme tip; wings quite clear; first recurrent nervure joining first cubital cell a moderate distance from end, second a little closer to end of second cubital cell; scutellum strongly and densely punctured like mesothorax; base of metathorax with coarse longitudinal plicae; first tergite very densely and strongly punctured; light parts of face sparsely and finely punctured; labrum, mandibles and lower margin of clypeus black. Length about 4 mm. (Mossel Bay).....*vau*, n. sp.  
Tegulae with a large yellow spot; first recurrent nervure at apical corner of first cubital cell, second meeting intercubitus; first tergite densely punctured (Graaff-Reinet).....*curvicarinatus* (Cameron).
- 4.—Larger and more robust; face broader (George).....*absonulus* Cockerell.  
Smaller and less robust; face narrower (Lady Grey).....*tenuis dominae* Cockerell.

*Hylaeus tinctulus* Cockerell

The male was described as having the legs wholly black, but additional specimens from Tshibinda show the anterior tibiae with a yellowish-white stripe in front. These were collected Aug. 26 (A. Mackie, J. Ogilvie). One from Rutshuru, 1° 15' S., 29° 30' E., Sept., 1914 (J. Bequaert), has the clypeal mark higher, with even margin, and the anterior tibiae red in front. It appears to have been reddened by cyanide, and is certainly the same species.

In addition to the original female, I have ten specimens from Tshibinda, Aug. 22, 26, and 27 (J. Ogilvie, A. Mackie, W. P. Cockerell, T.D.A. Cockerell). Two females were taken by Dr. J. Bequaert on Mt. Ruwenzori, 0° 30' N., 29° 50' E., June 5, 1914, at 1400 m.

The female is easily known from *H. atriceps* Friese and *H. melanosoma* Cockerell by the submetallic abdomen, with first tergite campanulate. A female from Behungi, Uganda, April 4, 1927, is unusually robust, and may represent a distinct race. It was taken by Dr. J. Bequaert.

*Hylaeus tinctulus extensicornis*, new subspecies

FEMALE.—Face narrower below; flagellum longer; wings clear, not brownish.

Belgian Congo: Burunga, 1° 30' S., 29° 18' E. (J. Bequaert). Alt. 1800 m.

*Hylaeus varians*, new species

MALE.—Length about 5 mm., anterior wing 3.5; black, slender, with narrow parallel-sided abdomen; labrum, mandibles, tubercles and tegulae black; eyes swollen, orbits strongly converging below; clypeus long and narrow; clypeus and lateral marks creamy white, no supraclypeal mark; lateral marks on inner side going above level of clypeus, very broad, but rapidly narrowing to a point on orbit, the whole mark having the shape of a cocked hat; frontal keels angular in middle; scape swollen, black; flagellum bright red beneath; collar with no hair-band; mesothorax dull, finely punctured, scutellum more shining; area of metathorax with strong plicae; posterior truncation densely punctured; wings hyaline, faintly grayish; stigma dark brown, nervures paler; both recurrent nervures meeting intercubiti; legs mainly black, but anterior tibiae light red in front, hind basitarsi (but not small joints) white; abdomen dull, first tergite swollen, campanulate, excessively minutely punctured; no hair bands.

Variety *a*.—Hind tibiae broadly white at base.

Variety *b*.—Face with the light area distinctly yellow; lateral marks more extended above; hind tibiae with a white spot at base.

Variety *c*.—Face-marks creamy white, but a black band down each side of clypeus; margin of first tergite with a little stripe of white hair on each side; hind tibial spot minute.

Southern Rhodesia: Christmas Pass, Umtali, May 20–21, 1932, four males (Alice Mackie). At first I thought I had several species, but on

close study, they appear to be individual variations of one. The species is allied to *H. melanosoma*, but easily distinguished by the much broader lateral marks of face. *H. melanosoma* is nearest to the variety *c*.

***Metylaeus semlikiensis*, new species**

FEMALE.—Length about 5 mm., anterior wing 4; black, the head entirely black, including mandibles and antennae; two transverse yellow marks on collar, separated by a distance equal to the length of one; large yellow spots on tubercles (these marks in type somewhat reddened by cyanide); tegulae narrow, dark brown; legs black. Face broad, clypeus dull and coarsely punctured, but there is a polished area involving upper end of clypeus and lower end of supraclypeal area; front dull and very densely punctured; mesothorax dull and densely, coarsely punctured, a little shining between punctures posteriorly; scutellum coarsely punctured, produced into a lamina on each side, and the posterior part with two transversely oval shining pits, separated by a keel; postscutellar spines thorn-like, curved and slender apically; area of metathorax very coarsely sculptured; posterior truncation dull, with a shining area at base; the margins of truncation sharply defined at sides and above, the lateral margins strongly angulate; wings hyaline, stigma reddish brown, nervures pale brown; second cubital cell very broad above; recurrent nervures received at apical corners of the cubital cells; first tergite very coarsely punctured, the following ones so finely that the punctures are barely visible under a lens; no hair-bands or spots; venter shining.

Belgian Congo: Kasonsero, Semliki Valley, Aug. 16, 1914 (J. Bequaert). Allied to *M. cribratus* Bridwell, from Nigeria, but differs by the black mandibles, lack of white hair-band on first tergite, and sharp curved postscutellar spines.

***Nothylaeus binotatus* (Alfken)**

Natal: Durban, Oct. 14–18, 1931 (J. Ogilvie).

Belgian Congo (Katanga): La Panda, Oct. 2, 1920 (Michael Bequaert).

These are females. The species has a remarkably wide range. The three females before me can be separated thus:

- 1.—Tubercles with a yellow margin..... Lobito Bay, Angola.  
Tubercles all red (as Alfken describes for type)..... 2.
- 2.—Wings faintly brownish; stigma dusky reddish..... La Panda.  
Wings grayish; stigma darker..... Durban.

But they are certainly variations of one species.

Alfken's long and principal description is of a female taken by Brauns at Uitenhage, Cape Province; but he describes the male from "Kimberley Reefs, Rhodesia," collected by Arnold, and Windhoek, Southwest Africa. We should consider the female to be the holotype, were it not that Alfken definitely states that the Arnold specimen is the type. There is one specimen of this species in the Rhodesian Museum.



*Nothylaeus braunsi* variety *nigricans* (Fries)

Transvaal: Wonderboom, near Pretoria, October (J. Ogilvie). Female.

*Nothylaeus fortis*, new species

MALE.—Length about 9 mm., anterior wing 7.2; robust, black, without red on head, thorax or abdomen, except that the mandibles have the apical half dusky red; face below level of antennae bright lemon-yellow, with the lateral marks extending as a band which ends obtusely some distance up orbit, the whole lateral mark like a foot on tip-toe; supraclypeal mark large, hat-shaped, narrowing but broadly truncate above; labrum shining black; clypeus rugosely punctured, dullish, with a median depression in upper part, but the lower part swollen, the narrow apical margin dark red; antennae entirely black; tubercles, and an interrupted stripe on collar, bright yellow, but scutellum all black; mesothorax dull, very coarsely punctured; scutellum more shining, but well punctured; area of metathorax very coarsely rugosopunctate; sternum with dense white hair; tegulae chestnut-red; wings dilute fuliginous; stigma large, very dark reddish; nervures dark brown; basal nervure nearly reaching intercubitus; first recurrent nervure meeting intercubitus, or falling a little basad of it; legs very dark reddish; front legs with a pale yellow knee-spot, and tibiae clear red in front; abdomen with the punctures excessively minute, first tergite dull; sides of apical margin of first tergite with a broad band of appressed white hair; first sternite raised in middle, with a groove down the raised portion, apical margin deeply emarginate; middle of third sternite with a large transverse slightly arched callus.

Belgian Congo: type from Lubutu, 0° 40' S., 26° 40' E., Jan. 20, 1915. Also one from Walikale, 1° 25' S., 28° E., Jan. 7, 1915. Both collected by Dr. J. Bequaert.

Related to *N. heraldicus*, which it resembles in the structure of the abdomen, but easily known by the lack of red, and the bright yellow markings.

*Nothylaeus heraldicus* (Smith)

Belgian Congo: Beni, 29° 30' E., 0° 30' N., May 1, 1914, female (J. Bequaert); Lubumbashi, Katanga, March 18, 1921, male (Michael Bequaert).

Southern Rhodesia: Matopo Hills, April, 1932 (J. Ogilvie). Male.

In its wide range this species varies. The specimens before me separate thus:

- 1.—Males.....2.
- Females.....4.
- 2.—Larger; stigma light reddish; collar with an interrupted orange stripe.  
Umlaas Road, Natal.
- Smaller; stigma dark brown.....3.
- 3.—Collar marked with orange.....Matopo Hills.
- Collar red, without orange.....Lubumbashi.

- 4.—Large; stigma pale reddish with a dark margin; scutellum very coarsely punctured..... Greytown, Natal.  
 Stigma dark red or dark brown.....5.  
 5.—Clypeus flattened or almost concave, its apical margin light red, and the sides suffused with red.....Durban, Natal.  
 Clypeus not thus flattened, rather more evidently punctured.....6.  
 6.—Apical corners of clypeus broadly dark (black and reddish); collar marked with yellow; wings brownish.....Stellenbosch, Cape Province.  
 Apical margin of clypeus dark red, most narrowly in middle; collar without yellow; wings clear.....Beni.

The species was described from a female, said to be from the Cape of Good Hope, having the clypeus marked as in the Greytown example. Strand's variety *rufipictus*, with the face-marks all red, may perhaps have been affected by cyanide. Cameron described the species as *Prosopis rubriplagiata*, from Dunbrody and Grahamstown, Cape Province.

#### **Nothylaeus heraldicus maculipes**, new subspecies

FEMALE.—Length about 7.7 mm.; light face-marks dull pale yellow, the supra-clypeal mark very large and well developed; clypeus well punctured, not flattened, its apical corners broadly dark red, the red triangular areas meeting narrowly in the middle line; scape and base of flagellum red, but the rest of the flagellum mainly black, but reddened beneath; collar and tubercles red, without yellow; scutellum somewhat shining, with punctures running in transverse lines; wings hyaline, faintly grayish, with dark stigma and nervures, the stigma rather small; femora more or less dusky, the hind ones mainly black; hind tibiae very dark reddish, with nearly the basal half cream color; abdomen black, with the first tergite red at sides and base, and the apical tergite red.

Belgian Congo (Katanga): Tenke, July-Aug., 1931 (J. Ogilvie). Recognized by the marking of the hind legs and various other characters, which appear to indicate a valid subspecies.

#### **Nothylaeus junodi** (Friese)

Belgian Congo (Katanga): Lubumbashi, Dec. 23, 1920, and Jan. 15, 1921, males (Michael Bequaert). These have the wings suffused with brownish; face-marks, lemon-yellow. The American Museum has a male from Bulawayo, Southern Rhodesia. In Friese's table the male runs to *N. braunsi*, but is easily separated by the yellow marks on scutellum.

#### **Nothylaeus libericus**, new species

FEMALE.—Length about 6.5 mm., anterior wing about 5; black, robust, the simple acute mandibles chestnut red; face broad, the clypeus and supraclypeal area black, dull and densely punctured; triangular lateral face-marks pale dull yellow,

broad at level of top of clypeus, the upward and downward sloping sides about equally long; scape in front, and flagellum beneath, chestnut red; area between antennae elevated, coarsely punctured, bounded on each side by a keel; collar with a very thin and slender grayish-white hair-band, and faint traces of two yellowish spots; tubercles broadly pale yellow; mesothorax extremely coarsely punctured; scutellum immaculate, coarsely punctured in front, posteriorly bigibbous, the elevations shining; postscutellum large, triangular, swollen, shining, with a row of punctures at extreme base; base of metathorax with a shining channel crossed by rugae; posterior truncation dull, with a median sulcus; tegulae brown, with a small yellow spot in front; wings bronzy hyaline, stigma and nervures dark brown; first recurrent nervure joining first cubital cell some distance from apex; second recurrent meeting outer intercubitus; middle coxae with a light spot; femora brownish black; front tibiae swollen, shining light red in front; hind tibiae white at base, otherwise pure black (contrasting with the brownish femora); tarsi mainly black, rufous at end; abdomen robust, dullish, without evident sculpture as seen under a lens, first tergite with a transverse patch of dense clear white hair on each side.

Liberia: Memeh Town, Aug. 29, 1926 (J. Bequaert). Allied to *N. peringueyi* Bridwell, from Nigeria, but easily known by the black clypeus and structure of scutellum. There is some approach to Bridwell's subgenus *Anylaeus*.

#### *Nothylaeus umtalicus*, new species

MALE.—Length about 6.3 mm., anterior wing 5; black, without red on head, thorax or abdomen, except that the labrum and mandibles are red, the scape is red in front and the flagellum is very obscurely reddish beneath; face broad, dull, entirely bright orange below level of antennae; the supraclypeal mark orange, rather high, rounded above, with a keel at each side; lateral face-marks very broad at level of lower part of supraclypeal mark, but rapidly narrowing, the margin almost transverse, ending on orbit at about level of antennae; upper part of clypeus with a pair of longitudinal depressions; thorax without yellow marks; mesothorax dull, very coarsely punctured; scutellum shining between the punctures; area of metathorax triangular, sharply defined, coarsely rugose; tegulae small and black; wings strongly suffused with brown; stigma and nervures dark brown; basal nervure almost meeting nervulus; recurrent nervures meeting intercubiti; legs black, with the anterior tibiae chestnut red in front; abdomen black, first tergite with a short white marginal hair-band on each side; apex of second tergite strongly depressed, forming a broad shining channel; third sternite simple.

Southern Rhodesia: Christmas Pass, Umtali, May 20–21, 1932 (J. Ogilvie). Runs in Friese's table to *N. braunsi* (Alfken), which has a much paler face, and red legs. The face-markings are much as in *N. bevisi* (Cockerell), but that also has red legs.





## CENSUS OF PALEOCENE MAMMALS

BY GEORGE GAYLORD SIMPSON

In the course of a general review of the Paleocene and more detailed work on particular Paleocene mammalian faunas it was necessary to compile a list of all the definitely identified genera yet found in the Paleocene formations of the world. The information is widely scattered in over a hundred papers by twenty-five or thirty authors, and the publication of this generic list will facilitate not only the task of identifying Paleocene mammals but also any effort to learn something of these important faunas.

The formations recognized and their designations in the list are as follows:

Europe: Cernaysian, a local stratum in the upper part of the Thanetian, Upper Paleocene, in the Mont de Berru at Cernay-les-Reims, near Reims, France. Designated as "Cernay." A few of these genera, but no others, have also been found elsewhere in the Thanetian.

Asia: Gashato, an Upper Paleocene formation of very limited known extent at Shabarakh Usu in Outer Mongolia (the Mongolian Republic). Designated "Gashato."

South America: Río Chico, a formation probably of Upper Paleocene age in and near the coastal region of central and southern Chubut (central Patagonia), Argentina. The isolated faunules may be of different ages. Genera found in the uppermost stratum, transitional to the Casamayor Eocene, are designated "Upper Río Chico," others simply "Río Chico."

North America: Puerco, so designated, restricted to the true Puerco, Lower Paleocene of the San Juan Basin, New Mexico. Torrejon, so designated, restricted to the true Torrejon, Middle Paleocene, of the San Juan Basin, New Mexico. Tiffany, so designated, restricted to the true Tiffany, earlier Upper Paleocene of the northern San Juan Basin, Colorado.

Ruby, so designated, a formation of Upper Paleocene and Lower Eocene age in western Colorado. Only occurrences in the lower

Ruby, Paleocene are listed.

Paskapoo, so designated, of Alberta, Canada. The formation may cover a wider span, but the known mammals are all of Upper Paleocene age.

Fort Union, a group of formations covering most or, in places, all of the Paleocene. The name "Fort Union" is used very differently by different authors and has become very ambiguous. The important faunas are: that of the Crazy Mountain Field, central Montana, designated "Crazy Mountain Fort Union," the fossils all of approximately Torrejon age as far as known; that found at Bear Creek, southern Montana, designated "Bear Creek," of Upper Paleocene approximately Tiffany age or slightly later; and the three successive faunas found by Jepsen in Park County, northern Wyoming, designated "Fort Union 'Puerco,'" "Fort Union 'Torrejon,'" and "Fort Union 'Tiffany,'" from their age equivalence. Local names for these divisions are necessary but not published.

Clark Fork, so designated, later Upper Paleocene of the Clark Fork-Bighorn Basin, northern Wyoming, between the "Fort Union 'Tiffany'" and Sand Coulee, Lower Eocene.

In addition to the published literature, most of the original collections have been examined and Matthew's unpublished Puerco-Torrejon memoir read. Unpublished genera are not listed, but in several cases genera named in papers still in press when this manuscript was written are included. The latest revisions and my own opinion derived from the specimens are followed in the taxonomy, and synonymous genera are not listed. Genera marked \* also occur in the Lower Eocene; others are confined to the horizons noted.

#### MULTITUBERCULATA

##### Phylodontidae

##### *Kimbelohia*

Simpson, 1936. Puerco.

##### *Eucosmodon*

Matthew and Granger, 1921. Puerco, Torrejon, Fort Union "Torrejon," Crazy Mountain Fort Union.

##### *Phylodus*

Cope, 1881. Torrejon, Crazy Mountain Fort Union, Fort Union "Torrejon," Fort Union "Tiffany?," Paskapoo?

##### *Ectypodus*

Matthew and Granger, 1921, Tiffany, Fort Union "Tiffany," Paskapoo, Crazy Mountain Fort Union?

##### \**Parectypodus*

Jepsen, 1930. Fort Union "Tiffany," Crazy Mountain Fort Union, Clark Fork.

##### *Microcosmodon*

Jepsen, 1930. Fort Union "Tiffany."

##### *Neoplagiularx*

Lemoine, 1882. Cernay.

##### *Liotomus*

Cope, 1884. Cernay.

## Taeniolabididae

*Taeniolabis*

Cope, 1882. Puerco.

*Catopsalis*

Cope, 1882. Torrejon, Paskapoo.

*Prionessus*

Matthew and Granger, 1925. Gashato.

*Sphenopsalis*

Matthew, Granger and Simpson, 1928. Gashato.

## MARSUPIALIA

## Didelphidae

*Thylacodon*

Matthew and Granger, 1921. Puerco.

*Peradectes*

Matthew and Granger, 1921. Tiffany.

## Borhyaenidae

*\*Patene*

Simpson, 1935. Río Chico.

## Polydolopidae

*\*Polydolops*

Ameghino, 1897. Río Chico.

*Seumadia*

Simpson, 1935. Río Chico.

## INSECTIVORA

## ?Deltatheridiidae

*Gelastops*

Simpson, 1935. Crazy Mountain Fort Union.

Palaeoryctidae<sup>1</sup>*Palaeoryctes*

Matthew, 1913. Torrejon.

## Leptictidae

*Prodiacodon*

Matthew, 1929. Torrejon, Crazy Mountain Fort Union.

*Acmeodon*

Matthew and Granger, 1921. Torrejon.

*Myrmecoboides*

Gidley, 1915. Crazy Mountain Fort Union.

*Emperodon*

Simpson, 1935. Crazy Mountain Fort Union.

*Leptacodon*

Matthew and Granger, 1921. Tiffany, Fort Union

"Tiffany," Bear Creek, Crazy Mountain Fort Union.

*Xenacodon*

Matthew and Granger, 1921. Tiffany.

*Litolestes*

Jepsen, 1930. Fort Union "Tiffany."

*\*Diacodon*

Cope, 1875. Fort Union "Tiffany," Paskapoo.

*\*Adapisorex*

Lemoine, 1883. Cernay.

*Proolestes*

Matthew, Granger and Simpson, 1929. Gashato.

## Nyetitheriidae

*Stilpnodon*

Simpson, 1935. Crazy Mountain Fort Union.

*Protentomodon*

Simpson, 1928. Bear Creek.

## Pantolestidae

*Pentacodon*

Scott, 1892. Torrejon, Bear Creek?

*Aphronorus*

Simpson, 1935. Crazy Mountain Fort Union.

*\*Palaeosinopa*

Matthew, 1901. Fort Union "Torrejon," Crazy Mountain Fort Union.

*Propalaeosinopa*

Simpson, 1927. Paskapoo.

## Apheliscidae

*\*Apheliscus*

Cope, 1875. Clark Fork.

## Mixodectidae

*Mixodectes*

Cope, 1883. Torrejon.

*Indrodon*

Cope, 1884. Torrejon.

*Eudaemonema*

Simpson, 1935. Crazy Mountain Fort Union.

<sup>1</sup>This and other notations, <sup>1</sup> to <sup>9</sup>, in this list refer to notes on page 8.



## ?Insectivora inc. sed.

- Picrodus* Douglass, 1908. Crazy Mountain Fort Union.  
*Coriphagus* Douglass, 1908.<sup>2</sup> Crazy Mountain Fort Union, Torrejon.  
*Megopterna* Douglass, 1908. Crazy Mountain Fort Union.  
*\*Adapisoriculus* Lemoine, 1885.<sup>3</sup> Cernay.  
*Pseudictops* Matthew, Granger and Simpson, 1929. Gashato.

## TILLODONTIA

- Esthonychidae  
*\*Esthonyx* Cope, 1874. Clark Fork.

## ?DERMOPTERA

- Plagiomenidae  
*Planetetherium* Simpson, 1928. Bear Creek.

## ?CHIROPTERA

- ?Phyllostomatidae  
*Zanycteris* Matthew, 1917. Tiffany.

## PRIMATES

- Plesiadapidae  
*Pronothodectes* Gidley, 1923. Crazy Mountain Fort Union.  
*\*Plesiadapis*<sup>4</sup> Gervais, 1877. Cernay, Tiffany, Fort Union "Tiffany,"  
 Bear Creek, Paskapoo, Clark Fork.  
*Chiromyoides* Stehlin, 1916. Cernay.  
 Apatemyidae  
*Labidolemur* Matthew and Granger, 1921. Tiffany, Bear Creek.  
 Carpolestidae  
*Elphidotarsius* Gidley, 1923. Crazy Mountain Fort Union.  
*Carpodactes* Matthew and Granger, 1921. Tiffany.  
*Carpolestes* Simpson, 1928. Bear Creek, Clark Fork.  
 ?Anaptomorphidae  
*Paramomys* Gidley, 1923. Crazy Mountain Fort Union.  
*Palaechthon* Gidley, 1923. Crazy Mountain Fort Union.  
*Palenochtha* Simpson, 1935. Crazy Mountain Fort Union.  
*Plesiolestes* Jepsen, 1930. Fort Union "Torrejon."  
*Navajovius* Matthew and Granger, 1921. Tiffany.  
 Primates inc. sed.  
*\*Phenacolemur* Matthew, 1915. Tiffany, Fort Union "Tiffany."

## TAENIODONTA

- Stylinodontidae  
*Wortmania* Hay, 1899. Puerco.  
*Psittacotherium* Cope, 1882. Torrejon, Crazy Mountain Fort Union.  
*(Psittacotherium or \*Calamodon* Cope, 1874). Bear Creek, Ruby.  
*Onychodectes* Cope, 1888. Puerco.  
*Canoryctes* Cope, 1881. Torrejon, Crazy Mountain Fort Union.

## EDENTATA

## Metacheiromyidae

*\*Palaeonodon*

Matthew, 1918. Clark Fork.

## Dasypodidae

## Gen. indet.

Río Chico.

## RODENTIA

## Eurymylidae

*Eurymylus*

Matthew and Granger, 1925. Gashato.

Ischyromyidae<sup>5</sup>

## CARNIVORA

Arctocyonidae<sup>6</sup>*Carcinodon*

Scott, 1892. Puerco.

*Loxolophus*

Cope, 1885. Puerco. Fort Union "Puerco."

*Oxyclaenus*

Cope, 1884. Puerco.

*Paradozodon*

Scott, 1892. Puerco.

*\*Chriacus*Cope, 1883. Puerco,<sup>7</sup> Torrejon, Fort Union "Torrejon," Crazy Mountain Fort Union, Tiffany, Paskapoo.*Metachriacus*

Simpson, 1935. Crazy Mountain Fort Union.

*Tricentes*

Cope, 1884. Torrejon, Fort Union "Torrejon," Crazy Mountain Fort Union.

*Spanoxyodon*

Simpson, 1935. Crazy Mountain Fort Union.

*Protogonodon*

Scott, 1892. Puerco.

*Deuteronodon*

Simpson, 1935. Crazy Mountain Fort Union.

*Prothryptacodon*

Simpson, 1935. Crazy Mountain Fort Union.

*\*Thryptacodon*

Matthew, 1915. Tiffany, Bear Creek, Clark Fork.

*Arctocyonides*

Lemoine, 1891. Cernay.

*Claenodon*

Scott, 1892. Torrejon, Fort Union "Torrejon," Crazy Mountain Fort Union.

*Arctocyon*

Blainville, 1841. Cernay.

## [Inc. sed.]

*Deltatherium*

Cope, 1881. Torrejon.

*Elpidophorus*

Simpson, 1927. Paskapoo.

*Hyracolestes*

Matthew and Granger, 1925. Gashato.

## Triisodontidae

*Eoonodon*

Matthew and Granger, 1921. Puerco, Fort Union "Puerco."

*Goniacodon*

Cope, 1888. Torrejon.

*Triisodon*

Cope, 1881. Torrejon.

## Mesonychidae

*\*Dissacus*

Cope, 1881. Torrejon, Tiffany?, Bear Creek, Clark Fork, Cernay.

*Microclaenodon*

Scott, 1892. Torrejon.

## Oxyaenidae

*\*Oxyaena*

Cope, 1874. Clark Fork.

*\*Dipsalidictis*

Matthew, 1915. Clark Fork.

*Dipsalodon*

Jepsen, 1930. Clark Fork.

## ?Hyaenodontidae

*Opisthopsalis*

Matthew, Granger and Simpson, 1929. Gashato.

## Miacidae

*\*Didymictis*

Cope, 1875. Torrejon, Crazy Mountain Fort Union, Clark Fork.

*Ichidopappus*

Simpson, 1935. Crazy Mountain Fort Union.

## Carnivora inc. sed.

*Sarcodon*

Matthew and Granger, 1925. Gashato.

## CONDYLARTHRA

## Phenacodontidae

*Tetraclaenodon*

Scott, 1892. Torrejon, Fort Union "Torrejon," Crazy Mountain Fort Union.

*Gidleyina*

Simpson, 1935. Crazy Mountain Fort Union.

*\*Phenacodus*

Cope, 1873. Tiffany, Fort Union "Tiffany," Bear Creek, Paskapoo, Clark Fork.

*\*Ectocion*

Cope, 1882. Fort Union "Tiffany," Paskapoo, Clark Fork.

## Meniscotheriidae

*\*Meniscotherium*

Cope, 1874. Paskapoo, Clark Fork.

*Pleuraspidothierium*

Lemoine, 1878. Cernay.

*Orthaspidothierium*

Lemoine, 1885. Cernay.

## Hyopsodontidae

*Mioclaenus*

Cope, 1881. Torrejon.

*Oxyacodon*

Osborn and Earle, 1895. Puerco, Fort Union "Puerco."

*Tiznatzinia*

Simpson, 1936. Puerco.

*Ellipsodon*

Scott, 1892. Torrejon, Crazy Mountain Fort Union.

*Protoselene*

Matthew, 1897. Torrejon.

*Litaletes*

Simpson, 1935. Crazy Mountain Fort Union.

*Litomylus*

Simpson, 1935. Crazy Mountain Fort Union.

*\*Haplomylus*

Matthew, 1915. Clark Fork.

*Haplaletes*

Simpson, 1935. Crazy Mountain Fort Union.

*Phenacodaptes*Jepsen, 1930,<sup>8</sup> Fort Union "Tiffany."

## Didolodontidae

*\*Ernestokokenia*

Ameghino, 1901. Río Chico.

## ?Condylarthra inc. sed.

*Phenacolophus*

Matthew and Granger, 1925. Gashato.

## AMBLYPODA

## Pantolambdidae

*Pantolambda*

Cope, 1882. Torrejon, Crazy Mountain Fort Union.

*Titanoides*

Gidley, 1917. Fort Union (near Buford, South Dakota), Ruby, Fort Union "Tiffany."

## Coryphodontidae

*\*Coryphodon*

Owen, 1845. Clark Fork.

## Periptychidae

*Ectoconus*

Cope, 1884. Puerco.

*Conacodon*

Matthew, 1897. Puerco, Fort Union "Puerco."

*Hemithlaeus*

Cope, 1882. Puerco.

*Anisomachus*

Cope, 1881. Puerco, Torrejon, Crazy Mountain Fort Union (also from an oil well in Louisiana).

*Haploconus*

Cope, 1882. Torrejon.

*Plagiptychus*

Matthew, 1936. Puerco.

*Periptychus*

Cope, 1881. Torrejon, Tiffany.

Tricuspidontidae

*Tricuspidodon*

Lemoine, 1885. Cernay.

## DINOCERATA

Uintatheriidae

*\*Probathyopsis*

Simpson, 1929. Clark Fork.

*Prodinoceras*

Matthew, Granger and Simpson, 1929. Gashato.

## LITOPTERNA

?Proterotheriidae

*Wainka*

Simpson, 1935. Río Chico.

*\*Victorlemoinea*

Ameghino, 1901. Río Chico.

*\*Ricardolydekkeria*

Ameghino, 1901. Río Chico.

*\*Josepholeidya*

Ameghino, 1901. Río Chico.

## NOTOUNGULATA

Arctostylopidae

*Palaeostylops*<sup>9</sup>

Matthew and Granger, 1929. Gashato.

Henricosborniidae

*\*Henricosbornia*

Ameghino, 1901. Río Chico.

?\*Polystylops

Ameghino, 1904. Río Chico.

?\*Postpithecus

Ameghino, 1901. Río Chico.

?Notostylopidae

Gen. indet.

Río Chico.

Isotemnidae

*\*Isotemnus*

Ameghino, 1897. Río Chico.

Notopithecidae

?\*Notopithecus

Ameghino, 1897. Río Chico.

?\*Transpithecus

Ameghino, 1901. Río Chico.

Acoelodidae

*Kibemikhoria*

Simpson, 1935. Río Chico.

Notoungulata inc. sed.

*Seidenius*

Simpson, 1935. Río Chico.

## ASTRAPOTERIA

Trigonostylopidae

*\*Trigonostylops*

Ameghino, 1897. Río Chico.

?Trigonostylopoidea inc. sed.

*Shecenia*

Simpson, 1935. Río Chico.

Mammalia inc. sed.

*Gashiernia*

Simpson, 1935. Río Chico.

*Carodnia*

Simpson, 1935. Río Chico.

*Ctalecarodnia*

Simpson, 1935. Río Chico.

## NOTES ON THE FAUNAL LIST

1. There is an unpublished probably palaeoryctid, but possibly deltatheridiid, genus in the Puerco (Reynolds).
2. *Coriphagus* may be an oxyclaenid. *Mixoclaenus* Matthew and Granger, 1921, is synonymous with it.
3. *Adapisoriculus* may be either didelphid or nyctitheriid. Referred specimens from the Lower Eocene are nyctitheriids, but their pertinence to the genus is not certain.
4. The survival of *Plesiadapis*, as such, into the Lower Eocene depends on an aberrant species that may not be placed in this genus when better known.
5. The occurrence of any ally of *Paramys* in the Upper Paleocene is known from a still undescribed specimen (Jepsen). I am indebted to Dr. Jepsen for the opportunity to include this very important new datum here.
6. There is an undescribed oxyclaenid genus in the Puerco (Reynolds).
7. The occurrence of *Chriacus* in the Puerco is known from an undescribed specimen (Simpson). It is very unlikely that one genus ranges from Lower Paleocene to Lower Eocene, but it cannot be split up on present data.
8. Jepsen referred *Phenacodaptes* to the Artiodactyla, with a query. This may be its true position, but so far as known to me the evidence much more strongly favors reference to the Hyopsodontidae.
9. *Palaeostylops* may include two related genera.

## NUMERICAL RÉSUMÉ

The numbers of families and genera listed are of some interest as affording a criterion of the richness of the faunas and the status of our knowledge of them. They are as follows:

## Whole Paleocene of the World

## Families:

Confined to the Paleocene.....	8
Cretaceous, Paleocene, and later.....	4
Paleocene and later.....	29
Later families doubtful in the Paleocene.....	6
Total.....	47

## Genera:

Confined to the Paleocene.....	113
Paleocene and Eocene.....	29
Eocene genera doubtful in the Paleocene.....	5
Undetermined but generically distinct from other Paleocene forms.....	2
Total.....	149

(Unpublished but known genera would add at least two confined to the Paleocene, making the present known total 151.)

## North America

## Lower Paleocene (Puerco and equivalents)

## Families:

Cretaceous, Paleocene, and later.....	2
Lower Paleocene to Eocene or later.....	3
Lower to Upper Paleocene.....	2
Lower to Middle Paleocene.....	1
Total.....	8

## Genera:

Confined to the Lower Paleocene.....	18
Lower Paleocene to Middle Paleocene.....	2
Lower Paleocene to Eocene.....	1
Total.....	21

## Middle Paleocene (Torrejon and equivalents)

## Families:

Cretaceous, Paleocene, and later.....	3
Lower Paleocene to Eocene or later.....	3
Lower to Upper Paleocene.....	2
Lower to Middle Paleocene.....	1
Middle Paleocene only.....	1
Middle to Upper Paleocene.....	2
Middle Paleocene to Eocene or later.....	7
Total.....	19

## Genera:

Lower Paleocene to Eocene.....	1
Lower to Middle Paleocene.....	2
Middle Paleocene only.....	43
Middle and Upper Paleocene.....	5
Middle Paleocene to Eocene.....	2
Total.....	53

## Upper Paleocene (Tiffany, Clark Fork, and equivalents)

## Families:

Cretaceous, Paleocene, and later.....	3
Lower Paleocene to Eocene or later.....	3
Lower to Upper Paleocene.....	2
Middle Paleocene to Eocene or later.....	6
Middle to Upper Paleocene.....	2
Upper Paleocene and later.....	13
Total.....	29

Genera:		
Lower Paleocene to Eocene.....	1	
Middle Paleocene to Eocene.....	2	
Middle to Upper Paleocene.....	6	
Upper Paleocene only.....	18	
Upper Paleocene and Eocene.....	15	
	<hr/>	
	Total.....	42
Europe—Cernaysian		
Families:		
Paleocene only (in Europe).....	4 <sup>1</sup>	
Paleocene and Eocene or later.....	4	
	<hr/>	
	Total.....	8
Genera:		
Paleocene only (in Europe).....	9	
Paleocene and Eocene.....	3	
	<hr/>	
	Total.....	12
Asia—Gashato		
Families:		
Paleocene only (in Asia).....	5 <sup>2</sup>	
Paleocene and Eocene or later.....	2	
	<hr/>	
	Total.....	7
Genera:		
Paleocene only.....	11	
	<hr/>	
	Total.....	11
South America—Río Chico		
Families:		
Paleocene and Eocene or later.....	11	
	<hr/>	
	Total.....	11
Genera:		
Paleocene only.....	9	
Paleocene and Eocene.....	12	
	<hr/>	
	Total.....	21

Except in the first list, for the whole world, doubtful identifications have been listed without distinction from those more certain.

<sup>1</sup> Three of these occur also in the Eocene in America and probably will be found there in Europe.

<sup>2</sup> Two of these occur also in the Eocene in North America.

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The types of genera marked \* are from the Eocene and in these cases the type description therefore does not refer primarily or at all to the occurrence of the genus in the Paleocene. Several other genera have since been found in the Eocene, but the type description is based on Paleocene occurrences. Including only type generic references, this bibliography is very much less extensive than would be one including all description and discussion of the Paleocene faunas.

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<sup>1</sup> This paper is going to press at about the same time as the present list, and will be American Museum Novitates, No. 849



# AMERICAN MUSEUM NOVITATES

Number 849

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

May 18, 1936

## ADDITIONS TO THE PUERCO FAUNA, LOWER PALEOCENE

BY GEORGE GAYLORD SIMPSON

The descriptions and comments here published were originally prepared as an appendix to 'Paleocene Faunas of the San Juan Basin, New Mexico,' by the late Dr. W. D. Matthew. Publication of this splendid memoir, one of the principal results of Doctor Matthew's life work, is still delayed and in the meantime it seems imperative to place the new forms here described on public record in order to facilitate general reviews of the Paleocene and more detailed work now in progress.

The specimens here described are from collections made by an American Museum party under my direction in 1929 and by University of California parties under C. L. Camp in 1928 and 1930. The latter collections were brought to the Museum in 1932 by R. A. Stirton for identification and when they were found to include two new forms and a more complete specimen of one already known he very kindly entrusted the description of these to me.

The American Museum 1929 collection includes three new species, described in this paper, and also a fine skull and skeleton of a crocodile, the first from the Paleocene (already briefly characterized),<sup>1</sup> a good skull and hind limb of *Plagioptychus coarctatus* (far the best known material of this genus), and numerous other specimens of known species. This material was placed in Doctor Matthew's hands in 1930 for inclusion in his memoir, and regarding the *Plagioptychus* skull he expressed the opinion that it proved the generic validity of that name (a subgenus in his original manuscript). He had, however, barely begun the study of these specimens when his fatal illness forced his sudden departure from the Museum and none of his observations on them were inserted by him in his manuscript. The *Plagioptychus* skull will be figured in his memoir. The present paper does not consider the new collection as a whole but only describes the new forms.

<sup>1</sup> Simpson, G. G. 1930. '*Allognathosuchus mooki*, a new crocodile from the Puerco Formation.' Amer. Mus. Novitates, No. 445.

## MULTITUBERCULATA

## Ptilodontidae

KIMBETOHIA,<sup>1</sup> NEW GENUS

TYPE.—*Kimbetohia campi*, new species.

DISTRIBUTION.—As for the type species.

DIAGNOSIS.—A genus of very small, earliest Paleocene multituberculates. Four upper premolars. Antepenultimate premolar with three cusps, one external and two internal, wider than long. Penultimate premolar nearly as large, rounded quadrate, with four equal cusps. Last premolar with well-developed inner cusp row, second row nearly complete but with several fewer cusps, and outer, third, row incipient (one cusp in type).

This very important specimen is wholly unlike anything previously found in the Puerco. Previous multituberculates from this formation have belonged to the genera *Taeniolabis* and *Eucosmodon*. The difference of the present form from *Taeniolabis* is too obvious to require further comment. Upper teeth of *Eucosmodon* are not known from the Puerco, but the type of this genus is so much smaller than any Puerco or Torrejon species of *Eucosmodon* that generic distinction is suggested,<sup>2</sup> and it differs generically from Torrejon specimens of upper premolars referred to *Eucosmodon*, as in the latter the penultimate premolar is relatively larger, and tends to be more complex, and the last premolar has only one complete row of cusps and one very incomplete row. It is also probable that at least the Torrejon species referred to *Eucosmodon* had only three upper premolars, whereas this form certainly had four, as in *Ptilodus*.

This genus differs from *Ptilodus* in the three-cusped antepenultimate premolar, slightly less reduced penultimate, and shorter, broader last premolar with the second row long but with only about half as many cusps as the inner row.

So far as present knowledge of it is concerned, *Kimbetohia* would make an admirable ancestor for *Ptilodus*, size and morphology suggesting a close but more primitive relative, in keeping with its greater age.<sup>3</sup> It has several times been remarked<sup>4</sup> that the known distribution of Paleocene multituberculates was peculiar in that the Puerco forms were much more specialized than the more common later forms, *Ptilodus*,

<sup>1</sup> Kimbetoh, the well-known arroyo and trading post near the type locality.

<sup>2</sup> Difference in size, in itself is not a generic character, but in practice contemporaneous species of very markedly different size commonly prove to belong to different genera.

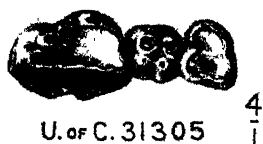
<sup>3</sup> So far as surely identified *Ptilodus* is confined to the Torrejon, and is also doubtfully reported in the Upper Paleocene, but not at any pre-Torrejon level.

<sup>4</sup> E.g., in: Granger, W. and G. G. Simpson. 1929. 'A revision of the Tertiary Multituberculata.' Bull. Amer. Mus. Nat. Hist., LVI, pp. 601-676 (p. 668).

*Ectypodus*, etc. The discovery of this specimen goes far to remove this anomaly.

*Eucosmodon gratus* Jepsen, from the basal Fort Union of Northern Wyoming, is of about the same size as this species, or perhaps even smaller, but no comparable parts are known. It may belong to *Kimbetohia*, but it is very improbable that the species are the same.

Fig. 1. *Kimbetohia campi*, new genus and species. Type, Univ. of California No. 31305, last three premolars of right upper jaw. Crown view. Four times natural size.



### *Kimbetohia campi*,<sup>1</sup> new species

TYPE.—Mus. Paleo. Univ. Calif. No. 31305, skull fragment with last three premolars and part of first of the right side. Collected by Camp and Vander Hoof, 1928.

HORIZON AND LOCALITY.—Lower fossil level, Puerco Formation, Bitonitsoseh<sup>2</sup> Arroyo, San Juan Basin, New Mexico.

DIAGNOSIS.—Only species surely referable to the genus as defined above. Last premolar with cusp formula probably 1:4:7 (outer:middle:inner). Measurements as below:

Measurements: Antepenultimate P	{ Length 1.9
	{ Width 2.2
Penultimate P	{ Length 1.7
	{ Width 1.8
Last P	{ Length 4.1
	{ Width 2.8

### CREODONTA

### Arctocyoniidae

### *Oxyclaenus simplex*

Mus. Paleo. Univ. Calif. No. 31270, from the upper level of the Puerco in Barrel Spring Arroyo, includes left P<sup>4</sup>-M<sup>3</sup>. As shown by the measure-

<sup>1</sup> Charles L. Camp.

<sup>2</sup> This is the local name, called "a nameles" (I have not seen the Indian name). It roughly approximates the pronunciation.



ments, it differs slightly in size and proportions from the type of *Oxyclaenus simplex*, but the structure is otherwise practically identical and it probably belongs to that species. *O. simplex* is a relatively rare species, in contrast to the fairly common *O. cuspidatus*, and  $P^4$  was not previously known. In this specimen it is similar to that of *O. cuspidatus*, but the protocone is still larger, nearly equal to the external cusp and closely applied to the latter.



Fig. 2. *Oxyclaenus simplex*. Univ. of California No. 31270, left upper  $P^4$ - $M^1$ . Crown view. Four times natural size.

		U. Calif. 31270	Type, Amer. Mus. 3107
Measurements: $P^4$	Length	4.6	...
	Width	5.9	...
$M^1$	Length	4.9	5.0
	Width	5.7	5.9
$M^2$	Length	4.9	5.5
	Width	6.5	7.0
$M^3$	Length	3.3	3.5
	Width	5.4	5.7

### *Chriacus antiquus*, new species

TYPE.—Amer. Mus. No. 27714, right upper jaw with  $P^3$  and  $M^1$ - $3$ . Found by A. C. Sawtelle, American Museum Expedition, 1929.

HORIZON AND LOCALITY.—Upper level, Puerco Formation, Barrel Spring Arroyo, San Juan Basin, New Mexico.

DIAGNOSIS.—Length  $M^1$ - $^3$  about 19.5 mm.  $P^3$  with distinct parastyle and small protocone. Hypocone strong on  $M^1$  and somewhat projecting internally, present on  $M^2$  but less internal, absent on  $M^3$  except as a cingulum. Cingula not complete around inner faces of protocones. No distinct protostyles, but anterior cingula present. External cingula evenly developed, with weak median embayment on  $M^1$ , not on  $M^2$ .  $M^3$  obliquely triangular, with strong parastylar projection. Enamel nearly smooth.

Fig. 3. *Chriacus antiquus*, new species. Type, Amer. Mus. No. 27714, right  $P^3$  and  $M^1$ - $^3$ . Crown view. One and one-half natural size.



This highly distinctive form is an unexpected element in the Puerco fauna. It somewhat resembles *Oxyclaenus* and *Loxolophus*, more especially the latter in the form of the molars, but is generically distinguished from either by the hypocones. Closest comparison is with the Torrejon genus *Chriacus*, in which I have placed it in the absence of any clear generic distinctions, although the strong specific differences and the rarity of genera common to the two formations suggest that it may eventually prove to belong to a new genus.

Measurements:  $M^1$ - $^3$  ca. 19.5 mm.

	Length	6
$P^3$	Width	4
	Length	7
$M^1$	Width	8
$M^2$	Length	7.5
	Width	10
$M^3$	Length	5.5
	Width	8

**Protogonodon grangeri,<sup>1</sup> new species**

TYPE.—Amer. Mus. No. 27713, lower jaws, cemented together, with roots of right C- $P_3$ , crowns of right  $P_4$ - $M_3$ , roots of left  $P_2$ - $^3$ , and crowns of left  $P_4$ - $M_3$  (that

<sup>1</sup> Dr. Walter Granger.

of  $M_1$  obscure on this side). Found by G. G. Simpson, American Museum Expedition, 1929.

**HORIZON AND LOCALITY.**—Upper level, Puerco Formation, Barrel Spring Arroyo, San Juan Basin, New Mexico.

**DIAGNOSIS.**—Length  $M_1$ - $_3$  29.5 mm. Molar proportions about as in *P. pentacus*, except that  $M_3$  is small, long and narrow, hypoconulid projecting and tending to form a third lobe.  $P_4$  low, protoconid little if any higher than that of  $M_1$ , anterointernal basal cusp (paraconid?) distinct, metaconid dependent on protoconid but likewise fully distinct, heel broad and well developed.

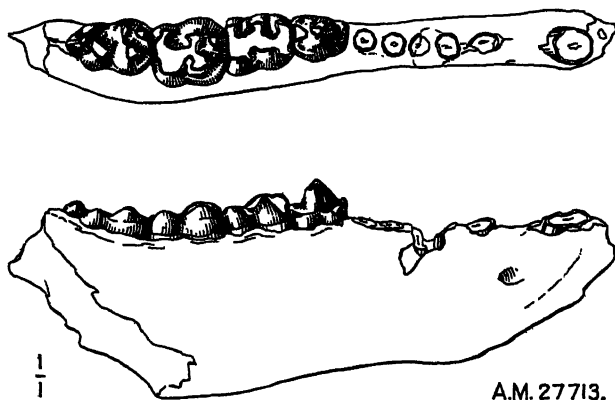


Fig. 4. *Protogonodon grangeri*, new species. Type, Amer. Mus. No. 27713, right lower jaw with crowns of  $P_4$ - $M_3$ . Crown and external views. Natural size.

The specimen is sharply distinct from any of *P. pentacus* or most other specimens referred to species of *Protogonodon* in the character of  $P_4$ , in those forms much higher, with metaconid entirely absent or at most very faintly suggested and basal cusp and heel less developed. This tooth in *P. grangeri* has made a distinct advance toward molarization, a step which does not contradict the decidedly creodont-like character of the genus as a whole but which does tend to link it with *Tetraclaenodon*, as originally suggested by Scott.

The only form previously referred to *Protogonodon* which resembles *P. grangeri* in this respect is a lower jaw (Amer. Mus. No. 16928) doubtfully referred by Matthew to *Protogonodon protogonioides*. This has a  $P_4$  of the same character as in *P. grangeri* although it is not the same species, being rather smaller and with distinctive molar proportions, especially  $M_3$  which has the trigonid distinctly narrower than the talonid and also relatively shorter.

It seems not unlikely that *Protogonodon* includes two distinct groups, one, typified by *P. pentacus*, more creodont-like and not far from *Loxolophus*, the other, typified by *P. grangeri* and probably including *P. protogonioides*, more condylarth-like and possibly near the ancestry of *Tetraclaenodon*. As Matthew points out, the two lines of possible relationship are not mutually exclusive, even though *Loxolophus* and *Tetraclaenodon* are commonly referred to distinct orders.

The essential agreement of all the species of *Protogonodon* is so close that it is not possible to split the genus on present evidence, although this would perhaps be necessary if skull and, still better, foot material should add significantly to the condylarth-like characters of the group here distinguished.

Measurements: $M_{1-3}$	29.5 mm.
$P_4$	{ Length 7.5
	{ Width 5.5
$M_1$	{ Length 8.5
	{ Width 7.5
$M_2$	{ Length 10
	{ Width 9
$M_3$	{ Length 10.5
	{ Width 7.5

## CONDYLARTHRA

### Hyopsodontidae

#### Mioclaeninae

#### TIZNATZINIA,<sup>1</sup> NEW GENUS

TYPE.—*Tiznatzinia vanderhoofi*, new species.

DISTRIBUTION.—Both fossil levels of the Puerco Formation, New Mexico

DIAGNOSIS.—A small condylarth most nearly similar to *Oxyacodon* and *Ellipsodon*.  $P_4$  little enlarged, slightly higher than  $M_1$  and not wider, with distinct but single-cusped heel, and very small incipient metaconid. Molars low-crowned, cusps relatively low and blunt, trigonids little elevated above talonids. Paraconids more or less reduced, but always present, closely approximated and usually almost directly anterior to metaconids, partly confluent with the latter. Trigonids with shallow basins, nearly or quite closed. Deep talonid basins open through a narrow notch on the inner side, hypoconids large, entoconids and hypoconulids smaller and poorly differ-

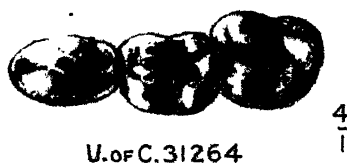
<sup>1</sup> Tiz Natzin, locality name given by Sinclair and Granger near the type locality of this genus and species.

entiated, frequently with other minute cuspsules on the talonid crescent.  $M_3$  (referred species) reduced, hypoconulids not strongly projecting.

This genus is clearly allied rather closely to *Oryacodon* and to *Ellipsodon* and is partly, but not altogether, intermediate between them. Its molar structure is very distinctive, having the blunter cusps, more turgid lower teeth, compressed trigonids, and reduced  $M_3$  of *Ellipsodon*, but retaining the paraconids as in *Oryacodon*. The paraconids are reduced, about to the same degree as in *Oryacodon*, but in a different way, remaining more internal and higher on the crown, and tending to become confluent with the metaconids, the trigonid basin being closed or somewhat open on the anterior side at least on  $M_{1-2}$ , not the internal as in *Oryacodon*. The genus, confined to the Puerco, seems to be nearly or directly ancestral to *Ellipsodon* of the Torrejon.

To this genus are also referred *Mioclaenus turgidunculus* Cope and *Ellipsodon priscus* Matthew. The former is referred by Matthew to *Oryacodon* but as shown by his description, and still more clearly by the specimens and in the light of the new species described below, it was highly atypical in that genus. *Ellipsodon priscus*, also, was very atypical

Fig. 5. *Tiznatzinia vanderhoofi*, new genus and species. Type, Univ. of California No. 31264, left  $P_4-M_2$ . Crown view. Four times natural size.



in the genus *Ellipsodon*, much more closely resembling its contemporary here described than it does the genotypic *E. inaequidens*. The three species seem clearly to form a natural and well-defined unit, contemporaneous with *Oryacodon*, but evolving in a somewhat different direction, toward the later *Ellipsodon*.

#### *Tiznatzinia vanderhoofi*,<sup>1</sup> new species

TYPE.—Mus. Paleo. Calif. No. 31264. Part of left lower jaw with  $P_4-M_2$ . Collected by Camp and Vander Hoof, 1930.

HORIZON AND LOCALITY.—Upper fossil level, Puerco Formation, Barrel Spring Arroyo, San Juan Basin, New Mexico.

<sup>1</sup> V. L. Vander Hoof.

DIAGNOSIS.—Size small (see measurements).  $P_4$  compressed. Trigonids of  $M_{1-2}$  subquadrate, paraconid wholly internal and larger and higher than in *T. priscus*.  $M_{1-2}$  longer than wide. Trigonid slightly narrower than talonid on  $M_1$ , wide on  $M_2$ . Mandible shallow.

Measurements: $P_4$	{	Length 3.5
	{	Width 2.3
$M_1$	{	Length 3.2
	{	Width 2.9
$M_2$	{	Length 3.5
	{	Width 2.9

This species is slightly smaller than either *T. turgidunculus* or *T. priscus*.  $P_4$  is more compressed and trenchant, the molar trigonids more quadrate, and the paraconids more strictly internal and more nearly confluent with the metaconids than in *T. turgidunculus*. The molars are relatively narrower and the paraconids relatively larger and somewhat higher on the crown than in *T. priscus*.

#### PLAGIOPTYCHUS MATTHEW *ex ms.*, NEW GENUS

TYPE.—*Periptychus coarctatus* Cope.

DISTRIBUTION.—Puerco Formation, San Juan Basin, New Mexico.

DIAGNOSIS.—Principal cusps of premolars pitched obliquely backward, the anterior basal cusps and deuterconids of lower premolars wider than long, the basal portion of the crown extended inwardly, supplementary cusps not developed on molars. (Matthew.)

From more fragmentary material, Matthew placed the Puerco species hitherto referred to *Periptychus*, the type of which is from the Torrejon, in a new subgenus. The new 1929 material led him to raise the subgenus to generic rank. *Plagiptychus* is discussed at greater length in Matthew's San Juan Basin memoir, and is published here in brief in order to record its elevation to generic value, after Matthew's notes but not inserted by him in his manuscript, and in order to publish the following new species in its correct and definitive form without publishing an invalid generic name.

#### *Plagiptychus matthewi*, new species

TYPE.—Amer. Mus. No. 27712, right lower jaw with  $P_2$ – $M_2$ . Found by G. G. Simpson.

HORIZON AND LOCALITY.—Upper level, Puercio Formation, Barrel Spring Arroyo, San Juan Basin, New Mexico.

DIAGNOSIS.—Over 10 per cent larger than average specimens of *P. coarctatus*. Lower premolars large and heavy.  $P_3$ – $P_4$  with small but distinct anterointernal basal cusp and well-developed heels.  $M_1$ – $M_3$  with well-defined median external basal cuspule and  $M_1$ – $M_2$  with smaller median internal basal cuspule.  $M_3$  elongate, with hypoconulid lobe partly differentiated.  $M_3$  at least ( $M_1$ – $M_2$  being too worn for determination) with incipient central seventh cusp.

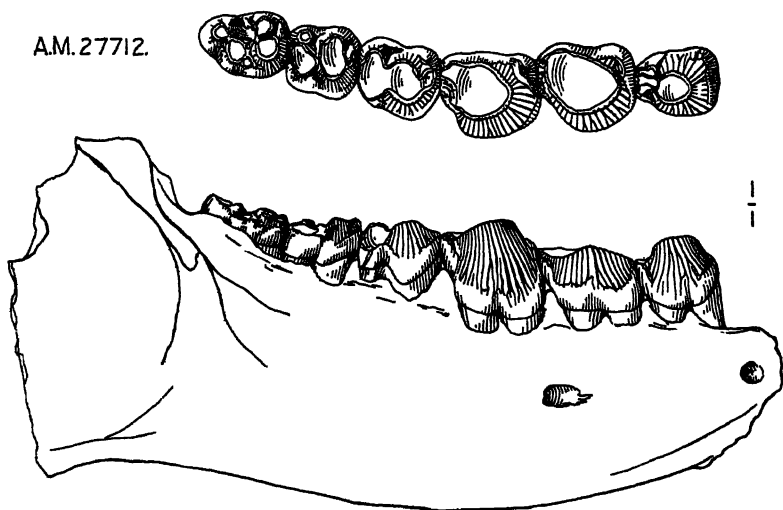


Fig. 6. *Plagioptychus matthewi*, new species. Type, Amer. Mus. No. 27712, right lower jaw with  $P_2$ – $M_3$ . Crown and external views. Natural size.

Some of the more fragmentary previously known specimens may belong to this species, but it differs sharply from any other with which full comparison can be made, in spite of their considerable range of variation. It is interesting that all the distinctive characters are progressive. All are in the direction of the true Torrejon *Periptychus*, although the species is nevertheless very much closer to *Plagioptychus coarctatus* and does not really close the gap between the two genera to any very significant extent. The premolars are too worn to show the presence or absence of a rudimentary metaconid, although its presence would be in harmony with the other characters of the species.

Measurements: P<sub>2</sub>-M<sub>3</sub> 69 mm.M<sub>1</sub>-M<sub>3</sub> 32P<sub>2</sub> { Length 11  
Width 8.5P<sub>3</sub> { Length 12.5  
Width 11P<sub>4</sub> { Length 13  
Width 11.5M<sub>1</sub> { Length 10  
Width 9M<sub>2</sub> { Length 10  
Width 9M<sub>3</sub> { Length 11  
Width 8.5





# AMERICAN MUSEUM NOVITATES

Number 850

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

May 20, 1936

## NEARCTIC SPIDERS OF THE GENUS *CICURINA* MENGE

By HARRIET EXLINE<sup>1</sup>

The purpose of this paper is to furnish a key and descriptions to the eighteen American species of *Cicurina* found north of Mexico. No specimens of *Cicurina nevadensis* Simon, *C. ludoviciana* Simon, *C. placida* Banks, *C. breviararia* Bishop and Crosby, and *C. cavealis* Bishop and Crosby have been available during this study, and the key does not include the first two mentioned. The other species are placed in the key on diagnoses taken from original descriptions and figures. The American species of this genus represent the majority of known cicurinas, the genotype *Cicurina cicurea* Fabricius being the only Palearctic species (Reimoser<sup>2</sup>), and *Cicurina madrynsensis* Tullgren being a Patagonian species (Petrunkévitch, 1911).

The morphological material dealing especially with the secondary sexual organs of the female, although somewhat cumbersome, has been included as a necessary foundation for separating closely allied species.

### BIONOMY OF SPECIES OF *CICURINA*

The habitat of the spiders of this genus is much the same as for many of the other Agelenidae. They are usually found in a cut-over or less dense woods, in rotting logs, or under boards or stones. Their webs are very delicate and fine, and they build no silken retreat. They are seldom seen in the daytime unless their habitation is disturbed. The most outstanding peculiarity of their life history has been noticed in connection with their maturation, which seems to occur at almost any time of year. Mature specimens of the Pacific Coast species of *Cicurina* have been collected in western Washington during all seasons. The climate of the latter district is seldom extreme and usually moist, but it is not common for most of the spider fauna to be mature during more than one or two seasons of the year. *Cicurina pusilla* Simon has been collected in February, March, April, May, August, September, and December; *Cicurina idahoana* Chamberlin in March, July, September, and December; *Cicurina simplex* Simon in May, July, September, and October. Eastern species are also mature during a large portion of the

<sup>1</sup> University of Washington.

<sup>2</sup> Reimoser, 1919, Abhandl. Zool.-Bot. Ges. Wien, Band X, Heft 2, p. 140.

year: mature specimens of *Cicurina robusta* Simon have been collected in March, April, May, June, July, August, September, October, and November.

#### ACKNOWLEDGMENTS

This paper has been made possible through the assistance and coöperation of Dr. W. J. Gertsch of The American Museum of Natural History who has lent part of his collection, supplied locality data, offered many suggestions, and read and made corrections in the manuscript. I am indebted to Miss Elizabeth B. Bryant of the Museum of Comparative Zoölogy at Harvard for her coöperation, suggestions, the loan of specimens, and sketches of *Cicurina placida* Banks; and to Professor Trevor Kincaid of the University of Washington, Dr. M. H. Hatch, and other members of the University staff under whose supervision the work has been done. The deepest appreciation and gratitude are expressed to these individuals for their help and encouragement.

#### CICURINA MENGE

MENGE, 1869, Preuss. Spinnen, IV, p. 272.

BANKS, 1905, The American Naturalist, XXXIV, p. 308.

COMSTOCK, 1913, 'The Spider Book,' pp. 584, 595, and 596.

The species of *Cicurina* present a group of Agelenidae with the hind spinnerets two-segmented, the apical segment of each of which is shorter than the basal segment, and eight eyes of approximately the same size. *Cicurina* differs from the nearest related genus, *Cryphoeca*, in having the anterior median eyes nearly as large as the others, and the clypeus higher than the diameter of the anterior lateral eyes. The two genera are closely allied in these respects, however, by such species as *Cicurina atomaria* Simon in which the anterior median eyes are very small, and perhaps by *Cicurina tersa* and *pusilla* Simon in which the width of the clypeus is very slightly greater than the diameter of the anterior lateral eyes.

GENOTYPE.—*Cicurina cicurea* (Fabricius).

#### *Cicurina cicurea* (Fabricius)

*Aranea cicurea* FABRICIUS, 1793, 'Entomologia Systematica,' II, p. 410.

Cephalothorax moderately rounded, narrowing to form cephalic division; chelicerae very slightly geniculate, with three teeth followed by several denticles on the lower margin of the furrow; anterior tibiae with 2-2 ventral spines, and three lateral spines on inner side; anterior eyes subequal in size and almost equidistant; posterior eyes subequal

in size, medians farther from each other than from the laterals; abdomen oval; anterior spinnerets well separated; posterior spinnerets longer than anterior spinnerets with short apical segment; epigynum with large posterior atrium leading anteriorly on each side through the atriobursal orifice into a well-developed bulb-shaped bursa; palpus of the male with the tibia armed on the outer side in the lower half with a short stout protuberance or apophysis and from the distal margin with a long, flat, keeled apophysis which extends over the cymbium; the embolus is long and coiled with a well-developed hooked conductor present.

The European genotype *Cicurina cicurea* (Fabricius) is very closely related to the American species, *Cicurina brevis* Emerton. The principal difference in the two species is in the size of the body, *Cicurina cicurea* being considerably the larger, and in the height of the clypeus which is greater in the genotype than in *Cicurina brevis*. The external reproductive organs agree very closely in the two species. Most of the other American species differ somewhat from the genotype in the structure of the epigynum; the bursa of these is not developed as a separate organ, but merges imperceptibly into a canal connecting the bursa and the receptaculum. In several American species, the armature of the anterior tibiae differs considerably also, the spines being long and more overlapping, and sometimes more numerous. This is especially true of the new species included in this paper, *Cicurina bryantae*.

#### STRUCTURE OF PALPUS AND EPIGYNUM

The separation of the species of *Cicurina* must be based principally on the morphology of the secondary reproductive organs, the male palpus, and the epigynum of the female. The structure of the male palpus is relatively simple, and the variations between species easily characterized. The patella of the palpus is without apophyses. The tibia bears two apophyses, a small, basal protuberance which is well chitinized and usually bluntly pointed in the middle, and the distal or principal apophysis which differs with the species, but is always a large, conspicuous chitinized plate. It is usually curled or grooved on one edge and grows out over the cymbium in all the American species except *C. pallida* Keyserling. The embolus is long and coiled and rests on a conductor which varies in size and shape. In two of our species, *C. simplex* Simon and *C. intermedia* Chamberlin and Ivie, there is a small, flat, square projection posterior to the principal apophysis. In several other species, including the genotype, a small outgrowth is present here, but it is not conspicuous.

To separate species of *Cicurina* it is necessary to understand the structure of the epigynum; although males are easily classified, many species are known only by their female representatives, and even in the species where both sexes are known, the female specimens are far more numerous in collections. The epigynum of the female is almost entirely underneath the layer of external chitin, so that it is hard to differentiate between closely allied species where the structures are similar and not easily studied, unless material is available to dissect out the structure from a sodium or potassium hydroxide preparation.

The internal organs of the epigynum are always connected to the external surface by an opening, the atrium, which is situated posteriorly near the epigastric furrow. It leads anteriorly on each side into a bursa (Petrunkévitch, 1925), a tubelike structure which is seldom as heavily chitinized as the other structures of the epigynum. The bursae usually extend from the atrium to the anterior margin of the epigynum. Each joins imperceptibly a more narrow, more heavily chitinized tube which is often twisted or convoluted in its course to the receptaculum seminis. This tube which varies greatly in different species is called after Petrunkévitch (1925) the "connecting canal" between the bursa and the receptaculum. The receptaculum may be a single sac- or bulblike organ as in the majority of the *Cicurina* species or it may be a double bulb or sac connected by a narrow neck as in *Cicurina robusta* Simon (see Fig. 21a). The receptaculum is nearly always heavily chitinized and often is one of the most conspicuous structures which shows through the external layer. It is emptied by a narrow simple duct, the "fertilization canal" which leads into the uterus.

The epigynum of *Cicurina pallida* Keyserling is comparatively simple. Although the subchitinous parts of the epigynum have not been dissected out during this study, their structure appears fairly certain through the chitin. The atrium is undeveloped to the extent that the central part is neither hollowed nor chitinized (see Fig. 12). The subchitinous structures appear to consist only of a pair of receptacula with short ducts leading into them. Undoubtedly the receptacula are drained by fertilization canals as in the other species.

Material has not been available to study the morphology of the epigyna of *C. atomaria* Simon, *C. placida* Banks, and several other species which are undoubtedly more complicated than *C. pallida*, but not so highly specialized as *C. brevis* Emerton, *C. tersa* Simon, or *C. pusilla* Simon.

In *Cicurina brevis* Emerton, which from its external form closely

conforms to the genotype, the large posterior atrium opens along its entire anterior margin through the atriobursal orifices into the bursae (see Fig. 13d). The bulb-shaped bursae are the largest organs of the epigynum and extend to the anterior margin. The opening between the bursa and the connecting canal, although not very clearly seen, opens on the ventral side of the bursa. The connecting canal extends posteriorly, becoming very heavily chitinized and forming three loops on the postero-lateral side of the bursa. It empties into the receptaculum, which is situated dorsal to the bursa on its posterior margin. The receptaculum is unusually large and bean-shaped, with the long axis corresponding to the long axis of the spider. Its wall is formed of a very thick layer of chitin so that the interior is not much larger than the receptaculum of other species; it is drained by a fertilization duct of the usual type extending from its posterior margin.

The epigynum in *Cicurina tersa* Simon and *C. pusilla* Simon is very similar in construction, differing principally in the length of the connecting canal between the simple bursa and the receptaculum; the connecting canal empties into the receptaculum at its base near the exit of the fertilization canal. The receptacula in both these species are a pair of small saclike organs situated on each side of the atrium underneath the external chitin (Figs. 15 and 17b). From a ventral view of the spider, however, they are almost invisible, because they are not well impregnated with chitin. The atrium is quite large and well developed.

In *Cicurina simplex* Simon and *Cicurina idahoana* Chamberlin (see Fig. 20a), the connecting canals are more tortuous, and empty into the bulblike receptacula which are nearly always conspicuous from the outside, due to their heavy chitinous wall. The connecting canals in these cases empty directly into the anterior part of the receptacula which are drained from the posterior margin by the fertilization ducts.

The most complicated form of epigynum is undoubtedly found in the closely related group, *Cicurina schultzi*, n. sp., *Cicurina gertschi*, n. sp., *Cicurina davis*, n. sp., *Cicurina intermedia* Chamberlin and Ivie, *Cicurina cavealis* Crosby and Bishop, and *Cicurina robusta* Simon. In the last-mentioned species the atrium is small and the bursa which leads out of it is more heavily chitinized than this part in most other species. A peculiar enlargement of the connecting canals is characteristic of this type of epigynum in the anterior part where the connecting canal makes its first bend. The connecting canal makes several wide loops on each side and finally empties into the more anterior of the pair

of receptacula, which are connected by a narrow tube. The fertilization duct drains the anterior bulb of the receptaculum from a point very near the entrance of the connecting canal (see Fig. 21a).

#### KEY TO SPECIES OF *Cicurina*

- 1.—Epigynum of female with atrium undeveloped, divided into two parts: principal apophysis of tibia of male palpus extending only slightly beyond tibia.  
*pallida* Keyserling.  
Epigynum of female with a single atrium; principal apophysis of the tibia of male palpus extending far beyond tibia.....2.
- 2.—Tibia I usually armed with 2-2 ventral spines and 3 single lateral spines on inner face, if there are 2-3 ventral spines, none is distal; spiders rarely over 5 mm. in length; chelicerae seldom geniculate.....3.  
Tibia I usually armed with 3-3 or 3-2 ventral spines, usually with at least one distal spine, 2, 3, or more lateral spines; spiders usually over 5 mm. in length; chelicerae geniculate.....9.
- 3.—Anterior median eyes only one-fourth as large as anterior lateral eyes.....4.  
Anterior median eyes no less than half as large as anterior lateral eyes.....5.
- 4.—Receptacula of epigynum lying medial to the connecting canals.  
*atomaria* Simon.  
Receptacula of epigynum lying under or lateral to connecting canals.  
*schultzi*, n. sp.
- 5.—Epigynum with bursa and connecting canals forming a pair of parallel, longitudinal bands; male with principal apophysis thin and extending only half the length of the cymbium.....6.  
Epigynum with bursa and connecting canals forming a pair of arcs that almost meet anteriorly; principal apophysis of male strong and extending beyond the middle of the cymbium.....8.
- 6.—Atrium of epigynum large and well rounded; males as above; anterior median eyes usually no larger than other eyes.....7.  
Atrium of epigynum a transverse slitlike opening; no males reported; anterior median eyes larger than other eyes.....*placida* Banks.
- 7.—Anterior median eyes much smaller than other eyes.  
*breviaria* Bishop and Crosby.  
Anterior median eyes very slightly or no smaller than other eyes.  
*brevis* Emerton.
- 8.—Bands formed by connecting canals and bursa not extending posteriorly to epigastric furrow. No males recorded.....*tersa* Simon.  
Bands formed by connecting canals and bursa extending posteriorly almost to the epigastric furrow. Males as in 4, part 2.....*pusilla* Simon.
- 9.—Posterior eyes in a straight or recurved row.....10.  
Posterior eyes procurved.....14.
- 10.—Four or five lateral spines on inner face of tibia I, spines long and posterior spines greatly overlapping (Figs. 6, 6a).....*bryantiae*, n. sp.  
Two or three lateral spines on inner face of tibia I.....11.
- 11.—Receptaculum single on each side of epigynum, posterior in position.....12.

- Receptaculum double on each side of epigynum, although anterior sphere of it is at times difficult to see.....13.
- 12.—Connecting canals of the epigynum showing through the chitin on each side as a horseshoe-shaped coil with the opening lateral; principal apophysis of male tibia without a chitinous projection preceding it. . . . .*idahoana* Chamberlin.  
Connecting canals of epigynum showing through chitin as a coiled S-shaped tube on each side; principal apophysis of male tibia with a flat square projection preceding it.....*simplex* Simon.
- 13.—Connecting canals not passing between the two spheres of the receptaculum on each side of the epigynum.....*gertschi*, n. sp.  
Connecting canals passing completely between the two spheres of the receptaculum on each side of the epigynum.....*davisi*, n. sp.
- 14.—Epigynum much wider than long, connecting canals of the two sides widely separated; principal apophysis of male palpus with flat square projection preceding it.....*intermedia* Chamberlin and Ivie.  
Epigynum almost square; connecting canals of two sides almost contiguous. .15.
- 15.—Connecting canals of female with the lateral loops horizontal, not extending anteriorly. No males described.....*cavealis* Bishop and Crosby.  
Connecting canals of female with the lateral loops definitely bending anteriorly; principal apophysis of male palpus with no projection preceding it.  
*robusta* Simon.

### *Cicurina pallida* Keyserling

#### Figure 12

*Cicurina pallida* KEYSERLING, 1887, Verh. Zool.-Bot. Ges., Wien, XXXVII, p. 462, Pl. VI, fig. 26.—EMERTON, 1909, Trans. Connecticut Acad. Arts and Sciences, XIV, p. 221, Pl. VIII, fig. 7.

FEMALE.—Cephalothorax, legs, mouth parts, and sternum almost uniform yellow-brown. Ventral surface of tibia I with 2-2 spines and 3 single spines on the median lateral surface; anterior eyes slightly procurved and well separated; posterior eyes recurved and almost equidistant; abdomen pale, mottled gray on grayish white; background without any definite pattern; epigynum with the receptacula showing through chitin as a pair of prominent sacs, and the atrium as two incompletely separated openings.

Measurements.—Length, 5.60 mm.; length of cephalothorax, 2.80 mm.; length of abdomen, 2.90 mm.; width of clypeus, 0.16 mm.; diameter of anterior lateral eyes, 0.12 mm.; length of tibia and patella I, 2.50 mm.; length of tibia and patella IV, 2.80 mm.

MALE.—Shape and coloring as in female; armature same except that there is often a single small spine on the median distal side of tibia I; palpus typical, with short basal apophysis on tibia, and longer distal apophysis, this latter apophysis broad and laminate, almost blunt at



tip and not so long as the tibia; conductor of embolus a slender, deeply curved hook.

Measurements.—Length, 4.70 mm.; length of cephalothorax, 2.40 mm.; length of abdomen, 2.30 mm.; width of clypeus, 0.14 mm.; diameter of anterior lateral eyes, 0.10 mm.; length of patella and tibia I, 2.20 mm.; length of patella and tibia IV, 2.60 mm.

TYPE LOCALITY.—Washington (D. C.). Type, male, Marx Collection in the National Museum.

DISTRIBUTION.—Indiana (cited by Petrunkevitch, 1911).—Massachusetts: Sharon and Northfield (Emerton, 1909).—Michigan: Ann Arbor, April 4, 1930, ♀ (E. L. Miner).—New Jersey: Alpine, April 25, 1909, ♀ (G. von Krockow).—New York: (cited by Petrunkevitch, 1911); Palisades on Hudson, Essex Co., ♂, ♀, May 31, 1908 (von Krockow), A. M. N. H.; Sea Cliff, Long Island, 3 ♀, 1 ♂ (Nathan Banks coll.), M. C. Z.—Pennsylvania: Bloomsburg, ♂, A. M. N. H.

#### *Cicurina brevis* (Emerton)

Figures 3, 5, 13a-d

*Tegenaria brevis* EMERTON, 1889, Trans. Connecticut Acad. Arts and Sciences, VIII, p. 30, Pl. VIII, fig. 5.

*Cicurina brevis* PETRUNKEVITCH, 1911, Bull. American Mus. Nat. Hist., XXIX, p. 530.

FEMALE.—Cephalothorax, legs, sternum, and mouth parts pale golden yellow, with considerable variation in intensity of color; legs, sternum, and mouth parts well clothed with hairs; venter of tibia I with 2-2 spines and 3 on the medial face; anterior eyes contiguous; anterior median eyes usually as large as the anterior lateral eyes, sometimes even larger; posterior eyes in straight line with median eyes farther from each other than from lateral eyes; abdomen of variable color; grayish white with few if any markings to light gray with definite dark gray markings; markings when present consist chiefly of median anterior stripe connecting with a row of paired median spots, very few lateral markings; epigynum conspicuous with a pair of heavy lateral bars outlining the sides, the bar effect given by the bursa and connecting canals which show through the epidermis; posteriorly there is a large atrium.

Measurements.—Length, 3.50 mm.; length of cephalothorax, 1.80 mm.; length of abdomen, 1.90 mm.; width of clypeus, 0.12 mm.; diameter of anterior lateral eyes, 0.10 mm.; patella and tibia I, 1.50 mm.; patella and tibia IV, 1.70 mm.

**MALE.**—Very pale; cephalothorax, legs, mouth parts, and sternum almost transparent white; cephalic part very blunt; spination, relations of eyes, and abdominal markings as in female; palpus rather small; first apophysis of tibia small; principal apophysis thin and narrow but curled on its dorsal side, extending a little over half way over the cymbium; conductor of the style exceedingly long, heavy, and hooked.

**Measurements.**—Length, 3.30 mm.; length of cephalothorax, 1.80 mm.; length of abdomen, 1.60 mm.; width of clypeus, 0.13 mm.; patella and tibia IV, 1.70 mm.

**TYPE LOCALITY.**—Mt. Washington, New Hampshire. Type specimen M. C. Z.

**DISTRIBUTION.**—Connecticut: New Haven (cited by Emerton, 1889).—Indiana: (Petrunkévitch, 1911).—Minnesota: Minneapolis, June 1, 1932, 2 ♀ (Gertsch); Itasca Park, 2 ♀, May 29–30, 1932 (Gertsch, A. M. N. H.).—New York: Cayuga Lake basin (Banks, 1892), M. C. Z.; Onondaga Co., Oct. 3, 1900, Britcher, deter. Gertsch, A. M. N. H.; Black Bear Mt., Sept. 27, 1916 (Miner), A. M. N. H.; near Sloatsburg, Sept. 22, 1934 (Gertsch) ♂♂, ♀♀, A. M. N. H.—North Carolina: Mt. Mitchell, Sept. 5, 1930, 1 ♀, P. J. Darlington, M. C. Z.—Ohio: Salineville (Nathan Banks coll.) 3 ♀, 3 ♂, M. C. Z.—Virginia: Falls Church, ♀♀, M. C. Z.

#### *Cicurina breviaria* Bishop and Crosby

*Cicurina breviaria* BISHOP AND CROSBY, 1926, Jour. Elisha Mitchell Sci. Soc., XLI, Nos. 3 and 4, pp. 196–198, Figs. 44, 45.

**MALE.**<sup>1</sup>—Cephalothorax yellow tinged with gray, very broad and convex with sides rounded; anterior eyes slightly procurved, close together, anterior median eyes much smaller than laterals; posterior eyes in very slightly procurved line, medians a little smaller than laterals, farther from each other than from laterals; abdomen grayish white with short median basal mark, with five pairs of small spots posteriorly; sides marked with diagonal rows of spots; venter light; tibia of palpus armed on outer, lower, distal angle with a rounded process larger and longer than that of *C. brevis*; principal apophysis broad and flat, deeply emarginate at end with tips rounded; embolus shorter than that of *C. brevis*, and conductor (acc. to figure) more hooked.

**Measurements.**—Length, 4.00 mm.

**TYPE LOCALITY.**—North Carolina: Grandfather Mt. (known only from holotype, male (coll. of Bishop and Crosby)).

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<sup>1</sup> Description adapted from original description as no specimens available for study.

*Cicurina placida* Banks

Figures 1, 9, and 11

*Cicurina placida* BANKS, 1892, Proc. Acad. Phila., p. 27, Pl. I, fig. 77.

FEMALE.<sup>1</sup>—Very similar in color and markings to *Cicurina brevis* Emerton; cephalothorax reddish yellow-brown; tibia I clothed with 2-3 ventral spines on inner face; anterior eye row slightly recurved, clypeus only slightly wider than anterior lateral eyes; anterior median eyes larger than other eyes, and slightly farther from each other than from anterior lateral eyes; posterior eyes in slightly procurved row, about equally spaced; reproductive plate with posterior atrium a wide transverse slitlike opening; the bursa and connecting canals seen indistinctly beneath the chitin as two almost parallel thickenings with a darkened longitudinal fold distinct in the center of each, and the posterior part near the atrium enlarged.

Measurements.—Length, 5 mm.

TYPE LOCALITY.—Upper Cayuga Lake Basin, New York (type specimens, Banks coll.), M. C. Z.

*Cicurina tersa* Simon

Figures 15 and 15a

*Cicurina tersa* SIMON, 1886, CR. Soc. Entom. Belgique, XXX, pp. 56-60.—BANKS, 1913, Acad. of Nat. Sci. of Phila., p. 18, Figs. 45, 48.

FEMALE.—Cephalothorax light brownish yellow and almost glabrous except for hairs in eye region and bristles down median line; proximal segments of legs same color, distal segments and mouth parts darker brown; sternum yellowish background mottled with gray especially around sides, and thickly clothed with hair; legs hairy; venter of tibiae I with 2-2 spines, distal third pair being replaced by bristles or hairs; anterior row of eyes procurved and almost contiguous, medians smaller than laterals; posterior row in a straight line (viewed from directly above); abdomen light gray, thickly clothed with dark hairs and with many well-defined dark gray markings which include the basal anterior area, and a median anterior mark which extends to the first third; the posterior two-thirds are marked with a series of dark arches; the sides are marked with dark gray splashes; the epigynum has a large median atrium posteriorly, and lateral to this the posterior ends of the connecting canals show through the epidermis and extend anteriorly on each side; the bursa open from the anterior lateral angle of the atrium and extend

<sup>1</sup> Type specimen not seen during this study. Description and drawings furnished by Miss Elisabeth B. Bryant of the Harvard Museum of Comparative Zoölogy

anteriorly, joining the connecting canal which swings laterally then curves directly forward, bends back posteriorly and straightens to open into the receptaculum, which lies immediately anterior to the atrium, one on each side.

Measurements.—Length, 4.80 mm.; length of cephalothorax, 2.10 mm.; length of abdomen, 2.80 mm.; width of clypeus, 0.11 mm.; diameter of anterior lateral eyes, 0.11 mm.; tibia and patella I, 2.00 mm.; tibia and patella IV, 2.10 mm.

TYPE LOCALITY.—Washington-territory. Type specimen presumably in Museum National d'Histoire Naturelle.

DISTRIBUTION.—British Columbia: Campbell R., Dec., 1918, ♀, A. M. N. H.—Washington: Seattle, March 15, 1934, Exline, ♀; Kincaid, ♀; March 14, 1932, Exline, ♀; July 24, 1931, Clarke, ♀; March, 1932, Iorns, ♀; Kincaid, ♀ ♀; North Bend, April 25, 1896, Kincaid, ♀ ♀; Stillaguamish R., March 20, 1932, Iorns, ♀; Olympia, Sept., 1931, Exline, ♀; White Horse Mt., May 15, 1932, Exline, ♀.

### *Cicurina pusilla* (Simon)

Figures 8, 17, 17a-b

*Cybaeus pusillus* SIMON, 1886, CR. Soc. Entom. Belgique, XXX, pp. 56-60.

*Cicurina pusilla* BANKS, 1913, Acad. of Nat. Sci. of Phila., p. 180, Figs. 34, 40.

FEMALE.—Cephalothorax light yellow-brown, shiny and almost glabrous; sternum and proximal segments of the legs same color, but mouth parts well clothed with fine hairs; anterior tibiae with 2-2 spines and 3 spines on the median face, with the distal third pair of spines found in many of the other species often replaced by bristles or hairs; anterior row of eyes procurved, about equal in size, posterior eyes slightly re-curved, almost equally distant, with posterior median eyes smallest; abdomen light gray, clothed with dark hairs, and with dark gray markings of which there are nearly always an anterior median longitudinal bar and a posterior series of curved transverse bands darkening posterior part; epigynum conspicuous, almost round, thickly clothed with hairs, with two dark curved bars representing the chitinous connecting canals outlining it, and with a large, although sometimes inconspicuous atrium in the posterior median region; the entire center of the epigynum light in color; the connecting canals extend from the epigastric furrow, where those of the two sides are separated by at least twice their diameter, curve around the epigynum to almost meet in the anterior medial region.

Measurements.—Length, 4.90 mm.; length of cephalothorax, 1.90 mm.; length of abdomen, 3.00 mm.; tibia and patella I, 1.60 mm.; tibia and patella IV, 2.00 mm.; width of clypeus, 0.10 mm.; diameter of anterior lateral eyes, 0.10 mm.

MALE.—Color and spination essentially as in female; palpus large, bearing a very long coiled embolus, the tip of which rests on a long hooked conductor; the tibia bears a short blunt apophysis proximally, and distally a very long flat apophysis, the lateral sides of which are both curled especially the dorsal side; this second apophysis extends two-thirds of the length of the cymbium.

Measurements.—Length, 4.60 mm.; length of cephalothorax, 2.10 mm.; length of abdomen, 2.50 mm.; width of clypeus, 0.12 mm.; diameter of anterior median eyes, 0.12 mm.; tibia and patella I, 2.10 mm.; tibia and patella IV, 2.20 mm.

TYPE LOCALITY.—Washington-territory (Simon). Type specimens probably in Museum National d'Histoire Naturelle.

DISTRIBUTION.—Oregon: Tillamook Co., Aug., 1931 (R. W. Macy), ♂, ♀.—Washington: Olympia, Sept. 12, 1931, Exline, ♂, ♀; Dec. 27, 1931, ♀; Seattle, April 6, 1931, Exline, ♀ ♀; April 26, 1933, Hatch, ♀; May 18, 1934, Exline, ♀ ♀; Oct. 3, 1930, Exline, ♀; Feb. 20, 1932, Exline, ♂; Kincaid, ♀ ♀; April 10, 1933, Hatch, ♀; March, 1932, Exline, ♀; April 13, 1932, Schwartz, ♀ ♀; May 15, 1932, Kincaid, ♀ ♀; Labar, Olympic Mts., Aug. 14, 1933, Exline, 3 ♀.

### *Cicurina nevadensis* Simon

*Cicurina nevadensis* SIMON, 1886, CR. Soc. Entom. Belgique, XXX, pp. 56-60.

FEMALE.<sup>1</sup>—Cephalothorax dark red-brown, marked posteriorly with dark radiating lines; legs reddish yellow, darker distally, short and stout; 2-2 ventral spines with 3 lateral spines on anterior tibiae; posterior eyes in straight row; medians much smaller than laterals, quite widely separated and equally spaced; anterior eyes large, nearly equal, in a slightly procurved row; abdomen blackish gray, marked in the posterior half with transverse black arches; epigynum dark brown, semicircular, with a large posterior atrium twice as wide as long.

Measurements.—Length, 6.00 mm.

TYPE LOCALITY.—Nevada (Simon). Type specimen presumably in Museum National d'Histoire Naturelle.

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<sup>1</sup> Description adapted from translation of original description.

*Cicurina atomaria* Simon

Figure 18

*Cicurina atomaria* SIMON, 1898, Ann. Soc. Entom. Belgique, XLII, p. 8.

FEMALE.—Cephalothorax brownish orange-yellow, smooth and hairless; chelicerae slightly darker and geniculate at base; legs and sternum slightly darker and brownish yellow, well clothed with hairs; anterior tibiae with 2-2 ventral spines and three single spines on medial side; anterior eyes in a straight row, with anterior median eyes almost touching anterior lateral eyes, but anterior median eyes well separated; anterior median eyes less than one-fourth as large as the anterior lateral eyes; abdomen gray with paired grayish white spots, which unite in the posterior region forming bars; epigynum with posterior transverse atrium, laterally a black coiled connecting canal outlining each side of the epigynum while medial to it lies the receptaculum of each side.

Measurements.—Length, 4.80 mm.; length of cephalothorax, 2.20 mm.; length of abdomen, 2.60 mm.; length of tibia and patella I, 1.70 mm.; length of tibia and patella IV, 1.90 mm.; clypeus, 0.17 mm.; diameter of anterior lateral eyes, 0.10 mm.

TYPE LOCALITY.—Louisiana (Simon). Type specimen presumably in the Museum National d'Histoire Naturelle.

DISTRIBUTION.—North Carolina: Mt. Leconte, Sept. 6, 1928 (W. M. Barrows).

*Cicurina bryantae*, new species

Figures 4 and 14

FEMALE.—Pale; cephalothorax light yellow with a few hairs in cephalic region; cephalic region well separated from thoracic region by cephalic groove; thorax slender; legs long, pale, and same color as cephalothorax, fairly stout, clothed with fine hair, and tibiae and metatarsi rather heavily spined; tibiae I with a variable number of spines (not same on two legs), 3-3 or 3-2 ventral spines without counting small distal pair, 3 to 4 lateral spines on inner face (see Fig. 6), spines long and overlapping; anterior row of eyes almost straight; clypeus not much wider than anterior lateral eyes; anterior median eyes only half as large as anterior lateral eyes, and farther from each other than from lateral eyes; posterior eyes recurved (in a dorsal view), medians a little smaller than laterals, and all about equidistant; chelicerae robust, slightly geniculate, each with a stout spine on the rounded inner face, spines of two chelicerae crossing in front; lower furrow of chelicerae with four stout teeth followed by several very small ones set close together; abdomen small, very pale grayish white, well covered with fine gray hairs; external reproductive plate pale yellow, almost square with a large atrium in the posterior part slightly separated by a partial anterior septum; the anterior bursa is somewhat distinguishable through the chitin, and laterally the dark connecting canals between the bursa and receptaculum seminis are clearly visible.

Measurements.—Length, 4.10 mm.; length of cephalothorax, 2.50 mm.; length of abdomen, 1.60 mm.; length of tibia and patella I, 2.00 mm.; length of patella and tibia IV, 2.10 mm.; clypeus, 0.10 mm.; diameter of anterior lateral eyes, 0.08 mm.

TYPE LOCALITY.—Newfound Gap, near Cherokee, North Carolina, Aug. 3, 1930. Type specimens (N. Banks coll.), M. C. Z.

*Cicurina idahoana* Chamberlin

Figures 10, 20, 20a

*Cicurina idahoana* CHAMBERLIN, 1919, *Annals Ent. Soc. of Amer.*, XII, p. 258, Pl. XIX, fig. 10.

FEMALE.—Cephalothorax, legs, sternum, and mouth parts light yellow-brown with tibiae, metatarsi, and tarsi of legs a darker brown (eye region and chelicerae also darker brown in some specimens); chelicerae somewhat geniculate at base; clypeus slightly wider than the diameter of the anterior lateral eyes; anterior lateral eyes and posterior lateral eyes contiguous and all a little larger than the anterior median eyes; spines on venter of tibia I, 3-2 or 3-3, with 3 lateral spines on median side; epigynum of variable brown color, broader than long with a small oval atrium situated posteriorly near the epigastric furrow, and with a pair of large connecting canals visible through the chitin forming a pair of horseshoe-shaped coils anteriorly; posterior to the canals and lateral to the atrium a pair of widely separated receptacula are indistinctly seen.

Measurements.—Length, 5.40 mm. to 7.00 mm.; length of cephalothorax, 2.30 mm.; length of tibia and patella I, 1.90 mm.; width of clypeus, 0.11 mm.; diameter of anterior lateral eyes, 0.10 mm.; length of tibia and patella IV, 2.20 mm.

MALE.—Color, shape, and spination essentially as in female; palpus large, tibia of pedipalp bearing a proximal triangular chitinous apophysis, and distally a broad flat apophysis which is slightly curled on the edges; no projection proximal to second apophysis; conductor of embolus with very short projection.

Measurements.—Length, 5.00-5.80 mm.; average length of cephalothorax, 2.40 mm.; length of tibia and patella I, 2.30 mm.; length of tibia and patella IV, 2.70 mm.; width of clypeus, 0.13 mm.; diameter of anterior lateral eyes, 0.10 mm.

TYPE LOCALITY.—Moscow Mts., Idaho. Type specimens (coll. of R. V. Chamberlin).

DISTRIBUTION.—British Columbia: (no specific data), A. M. N. H.—Washington: Olympia, March 24, 1932, Exline; Dec. 22, 1932, H. E.;

1933, Yates; Sept. 20, 1931, H. E.; Dec. 1, 1933, H. E.; Dec., 1929, Exline; March 26, 1931, Exline; Seattle, Kincaid, July, 1932, Exline.

*Cicurina simplex* Simon

Figures 19, 19a-c

*Cicurina simplex* SIMON, 1886, CR. Soc. Entom. Belgique, XXX, pp. 56-60.—BANKS, 1913, Proc. Acad. of Nat. Sci. of Phila., Figs. 35 and 38.

FEMALE.—Cephalothorax, legs, and mouth parts almost uniform light yellow-brown with tibiae and metatarsi of legs a little darker; width of clypeus very slightly greater than diameter of the anterior lateral eyes; eyes subequal in size; anterior median eyes dark and smaller than anterior lateral eyes, not so far from anterior lateral eyes as from each other; posterior eyes slightly recurved in dorsal view, and about equally distant from each other; tibia I with 3-3 ventral spines and 3 lateral spines on medial side; abdomen and venter grayish white thickly clothed with fairly long gray hairs; epigynum dark brown, almost square, but narrow anteriorly, with a small atrium broader than long near the epigastric furrow; a pair of receptacula widely separated in the posterior half, indistinctly visible through the chitinous exoskeleton, as well as the connecting canal on each side which extends from it anteriorly, curves back posteriorly and swings anteriorly to become lost from sight in another posterior curvature.

Measurements.—Length, 5.60 mm.; length of cephalothorax, 2.30 mm.; length of tibia and patella I, 2.60 mm.; distance from anterior lateral eyes to margin of clypeus, 0.11 mm.; longest diameter of anterior lateral eyes 0.10 mm.

MALE.—Size and color as in female; spines of anterior tibiae the same; eyes as above, but clypeus is slightly higher in comparison to the diameter of the anterior lateral eyes; palpus large, tibia bearing a small triangular chitinous apophysis on the proximal lateral side, and a very long flat, very broad, somewhat curled apophysis distally; proximal to the base of this second apophysis on the ventral margin is a small chitinous projection which does not appear in other species except in *C. intermedia* Chamberlin and Ivie; the conductor of the long coiled embolus bears a short curved projection.

TYPE LOCALITY.—Washington-territory (Simon). Type specimen probably in Museum National d'Histoire Naturelle.

DISTRIBUTION.—Montana: Hamilton, Ravalli Co., March 23, 1934, ♀, A. M. N. H.; Moose Lake, Ravalli Co., March 25, 1934, ♀, W. L. Jellison, A. M. N. H.—Washington: Seattle, Kincaid; July, 1932,



Exline; Olympia (Yates), Sept. 17, 1931; May, 1932, Exline; Oct. 19, 1931, H. E.

*Cicurina ludoviciana* Simon

*Cicurina ludoviciana* SIMON, 1898, Ann. Soc. Entom. Belgique, XLII, p. 8.

FEMALE.<sup>1</sup>—Cephalothorax yellow-brown, smooth and subglabrous; chelicerae strongly geniculate; legs long and heavily spined, yellow brown; sternum reddish yellow; anterior eyes procurved, anterior median eyes smaller than anterior lateral eyes; posterior eyes equidistant; posterior median eyes a little smaller than posterior laterals; abdomen yellowish brown, sparingly hairy; epigynum yellowish red, semicircular, heavily clothed with hair, with a half moon-shaped region glabrous and shiny.

Measurements.—Length, 9.00 mm.

TYPE LOCALITY.—Louisiana (Simon). Type specimen presumably in Museum National d'Histoire Naturelle.

*Cicurina schultzi*, new species

Figure 23

FEMALE.—Cephalothorax flat, gently curved sides, orange-yellow, glabrous and shiny except for a few scattered hairs. Chelicerae same color, quite hairy, a little geniculate at the base; lower furrow of fang with three teeth and several denticles toward the inner side. Mouth parts orange-yellow; sternum pale yellow, fitted quite close to coxae and extending posteriorly between hind coxae. Legs pale yellow, becoming more orange on distal segments, covered with long black hairs; spines on venter of tibiae I 2-2; on inner lateral side of one tibia type specimen bears two moderate spines and two small spines, other tibia bears only one moderate spine. Posterior eyes in a straight row, evenly spaced, and almost equal in size although laterals are slightly larger than the medians. Anterior eyes equally spaced, laterals considerably larger than the medians. The clypeus is not quite so high as the diameter of the anterior lateral eyes. (By these characters, this species would seem to belong to *Cryphoea* rather than to *Cicurina*. The structure of the epigynum, however, is certainly of the *Cicurina* type, and places the species between the *Cicurina robusta* group and the *Cicurina simplex* group.) The abdomen is grayish white and is clothed both dorsally and ventrally with very long black hairs.

The epigynum is formed with a conspicuous, large posterior atrium, from the anterior lateral margins of which the ductlike bursae lead anteriorly, each then folds back posteriorly and curves completely around the posterior ball of the receptaculum and probably curves back to empty into it. There are two separate parts of the receptaculum divided into an anterior and posterior ball on each side. The tubes are quite clearly visible for most of their length under the external chitin.

Measurements.—Length, 4.00 mm.; tibia and patella I, 1.60 mm.; tibia and

<sup>1</sup> Description adapted from translation of original description

patella IV, 1.80 mm.; height of clypeus, 0.06 mm.; diameter of interior lateral eyes, 0.10 mm.

**HOLOTYPE**.—Female, collected at McDowell Lake, Upper Anaconda Creek, Glacier National Park, Montana, Aug. 26, 1934, by L. P. Schultz, in the collection of The American Museum of Natural History.

*Cicurina schultzi*, new species, differs from *Cicurina simplex* in having the divided receptaculum of the epigynum, in which respect it is similar to the *C. robusta* group. It is smaller than any species of the latter group, however, and has the simpler connecting canals; the clypeus is lower and the median eyes are smaller than any other species in the genus except *C. atomaria* Simon.

### *Cicurina gertschi*, new species

#### Figure 22

**FEMALE**.—Cephalothorax pale yellow with faint brownish radiating impressions, and lightly infused with a deeper color toward the anterior lateral margins; cephalothorax gently rounded on the sides to the cephalic groove, anterior to which the lateral margins are straight and parallel with the head truncate across the front; cephalothorax shiny and glabrous except for a few hairs along the median line and scattered hairs elsewhere. Chelicerae a little darker than the cephalothorax, very geniculate, and protruding in basal third, with prominent lateral condyles; the furrow of the cheliceral fang is armed on its posterior margin with two teeth, the external one of which is especially large and has two points; on its ventral margin the furrow is armed with four teeth, the internal three of which are contiguous at their bases; the fang is well developed. The sternum is yellow with darker margins, almost round, clothed with many long hairs. The labium and endites and distal segments of the pedipalps are more orange in color, all well clothed with hair; the labium is only half as long as the endites; the tip of the pedipalp is armed with a strong claw. The legs are only moderately long, the basal segments yellow, the distal segments darkening into an orange brown; legs hairy; tibia I armed with 2 pairs of ventral spines and three weak spines laterally. Posterior eyes in a straight row, medians slightly smaller than laterals, and a little farther from each other than from lateral eyes. Anterior eyes (from front) procurved, medians a little smaller than laterals, and closer to each other than to lateral eyes; clypeus only slightly higher than the diameter of the anterior lateral eyes. Abdomen grayish white, irregularly spotted in the anterior part with light gray and more definitely streaked with gray posteriorly, quite gray around spinnerets the basal segments of which are light yellow with the distal ones white.

The epigynum is composed of a large posterior atrium; from the lateral sides of the atrium the connecting canals extend directly to the anterior margin of the epigynum without any intervening part to designate as bursal; the connecting canal on each side swings laterally and makes a conspicuous bend either ventrally, dorsally, or medially, from which the canal extends posteriorly and curves to enter the receptaculum in its median anterior margin. The receptaculum is rather small, almost round, and situated on the most lateral part of the epigynum and in the posterior half; a second reservoir or part of the receptaculum is faintly seen anterior

and dorsal to the prominent one. The fertilization canal is probably typical, but cannot be seen in the type specimen, and no material is available for dissection.

Measurements.—Length, 5.20 mm.; tibia and patella I, 1.40 mm.; tibia and patella IV, 1.70 mm.; height of clypeus, 0.08 mm.; diameter of anterior lateral eyes, 0.08 mm.

HOLOTYPE.—Female from Larch Creek, Ravalli Co., Montana, collected April 8, 1934, by W. L. Jellison, in the collection of The American Museum of Natural History.

This species is most closely related to *Cicurina schultzei*, new species, and was collected in the same general locality; the connecting canals of the epigynum do not differ greatly. The relative size of the anterior eyes and width of the clypeus separate the two species.

#### *Cicurina davisi*, new species

##### Figure 24

FEMALE.—Cephalothorax smooth, without noticeable cephalic groove, almost glabrous, with gently rounded sides. Chelicerae somewhat geniculate at base, on the inner angle a large spine on each chelicera; lower furrow armed with 5 or 6 small teeth, the inner ones very small. Cephalothorax, chelicerae, pedipalps, and legs light yellow. Sternum yellowish white, a little darker on the margins, very blunt in front, with a narrow point behind, extending half the way between the coxae. The endites and labium orange-brownish yellow. Posterior eyes in a straight row, almost equal in size and almost equally spaced, the medians being slightly further apart than they are from the laterals. Anterior eyes in a procurved row (seen from the front); medians smaller than the laterals, separated from each other almost by a diameter, and not quite so far from the lateral eyes. Clypeus not quite so high as the diameter of the anterior lateral eyes. Anterior tibiae armed with 2-3 spines underneath. Abdomen whitish gray mottled with gray spots which are only slightly darker than the background color.

Epigynum of the *C. robusta* type with two pairs of large receptacular sacs resembling balls visible through the chitin. The posterior opening into the bursae is minute; from it the narrow tubelike bursa leads anteriorly on each side, curves around the anterior ball of the receptaculum, probably passes between the balls and swings around the posterior ball, continues in an anterior course, then encircles the two balls together, taking a transverse path between the two halves and probably empties into the posterior ball of the receptaculum.

Measurements.—Length, 5.00 mm.; tibia and patella I, 1.40 mm.; tibia and patella IV, 2.00 mm.; height of clypeus, 0.09 mm.; diameter of anterior lateral eyes, 0.10 mm.

HOLOTYPE.—Female, collected December, 1934, at Llano (Llano Co.), Texas, by L. Irby Davis (A. M. N. H.).

This species which belongs in the *robusta* group resembles *Cicurina cavealis* very closely; it is smaller than the latter, however, and is similar to *C. robusta* in having a very small posterior opening as contrasted to the medium-sized one of *C. cavealis*; the connecting tubes of

the epigynum are not so long and tortuous as in *C. robusta*, or *C. intermedia*.

***Cicurina intermedia* Chamberlin and Ivie**

*Cicurina intermedia* CHAMBERLIN AND IVIE, 1933, Bull. of Univ. of Utah, XXIII, No. 4, p. 46, Pl. xi, figs. 116-118.

FEMALE.—Cephalothorax, sternum, and legs almost uniform yellow-orange-brown; chelicerae geniculate at base; tibiae I with 2-3 or 2-2 ventral spines (in specimens seen during this study; 3-3 in specimens of Chamberlin and Ivie), 3 lateral spines on medial face of tibia I; posterior eyes in procurved line; abdomen pale grayish white; epigynum with a short, wide posterior atrium, by which anteriorly the bursae and connecting canals are reached; connecting canals extend forward, make a lateral loop and empty into a receptaculum; receptacula divided into two sacs on each side which are probably united dorsally.

Measurements.—Clypeus, 0.10 mm.; anterior lateral eyes, 0.10 mm. (Note: Complete description, measurements, and figures given in the original description.)

MALE.—Similar to female, tibia of palpus with basal apophysis sharply pointed at tip; second apophysis short, extending but half the length of cymbium, broad at the base and narrowing to abrupt point; conductor of embolus a short slender hook.

TYPE LOCALITY.—Clear Creek, S. Fork of Raft River, Utah. Type specimens in collection of Chamberlin and Ivie.

DISTRIBUTION.—Utah: Salt Lake City, Aug., 1931 (Gertsch), A. M. N. H.; Fish Lake, Sevier Co., July 8, 1930 (Gertsch), A. M. N. H.—Oregon: Crater Lake, Sept. 12, 1932, Kincaid. Washington: Pullman (Nathan Banks coll.), M. C. Z.—Montana: Moose Lake, Ravalli Co., March 25, 1934, W. L. Jellison, A. M. N. H.—Minnesota: Itasca Park, May 30, 1932 (coll. Gertsch), A. M. N. H.—Note: These two female specimens from Minnesota are not typical of the species. They measure only 4.2 mm. in length, are very pale, and the connecting canals are not chitinized in the same proportions as in the more typical specimens. The atrium and connecting canals as well as the other general characters are too closely in agreement with this species, however, to consider them new without more available material.

***Cicurina cavealis* Bishop and Crosby**

*Cicurina cavealis* BISHOP AND CROSBY, 1926, Jour. of the Elisha Mitchell Sci. Soc., XLI, Nos. 3 and 4, p. 197, Fig. 46.

FEMALE.<sup>1</sup>—Cephalothorax reddish brown, strongly convex, sides constricted toward front; anterior eyes slightly procurved, equidistant, medians smaller than laterals; posterior eyes slightly procurved, equidistant, medians slightly smaller than laterals; legs and palpi lighter than cephalothorax; abdomen yellowish gray marked with numerous dark patches with an indication of a chevron pattern on hinder half; venter dusky yellowish; epigynum resembling *C. robusta* Simon; atrium oval, posterior in position with connecting canals forming anterior and lateral loops; lateral loops, however, do not extend anteriorly as in *C. robusta*. Length, 7.00 mm.

TYPE LOCALITY.—Missouri, Rochport Cave, 3 specimens (coll. of Crosby and Bishop).

HOLOTYPE.—Female and 2 paratypes (coll. of Crosby and Bishop).

### *Cicurina robusta* Simon

Figures 21 and 21a

*Cicurina robusta* SIMON, 1886, CR. Soc. Entom. Belgique, XXX, p. 40.—CHAMBERLIN AND IVIE, 1933, Bull. of Univ. of Utah, XXIII, No. 4, p. 46.

*Cicurina arcuata* KEYSERLING, 1887, Verh. Zool.-Bot. Ges. Wien., XXIX, p. 530.—PETRUNKEVITCH, 1911, Bull. Amer. Mus. Nat. Hist., XXIX, p. 530.

*Cicurina utahana* CHAMBERLIN, 1913, Ann. Ent. Soc. Amer., XII, No. 3, p. 257, Pl. XIX, fig. 8.

FEMALE.—Cephalothorax, sternum, and proximal segments of legs pale yellow-brown; terminal segments of legs and mouth parts reddish brown; chelicerae geniculate at base; tibia I with 3–3 ventral spines and 3 lateral spines; eyes small and close together; anterior median eyes almost touching each other but further from the laterals which are larger; anterior and posterior lateral eyes almost contiguous; posterior eyes in a procurved row; abdomen, in pale specimens, almost uniform grayish white, thickly clothed with long fine hairs; in dark specimens, abdomen well marked with streaks and dashes of very dark gray, these forming in the mid-dorsal line a series of chevrons and almost solid dark color toward tip of abdomen, on the venter as well as the dorsal surface; epigynum variable in form depending on the transparency of the external chitin; a single median posterior atrium of small size leads anteriorly on each side into a bursa which joins the long and tortuous connecting canal; this makes conspicuous anterior and lateral loops and finally ends in the receptaculum which is divided into two sacs connected by a large canal; both sacs are often visible, though the posterior one is nearer the surface.

<sup>1</sup> Description taken from original description of Crosby and Bishop.

Measurements.—Length varies from 3.50 mm. to 7.60 mm.; length of a typical specimen, 7.10 mm.; length of cephalothorax, 3.20 mm.; length of abdomen, 4.00 mm.; width of clypeus, 0.12 mm.; diameter of anterior lateral eyes, 0.10 mm.; tibia and patella I, 2.10 mm.; tibia and patella IV, 2.60 mm.

MALE.—Coloring, armature of the tibiae, and the relation of eyes as in female; palpus large; tibia with principal apophysis large which extends three-quarters of the length of the cymbium, very broad in its proximal half, abruptly narrowing distally; conductor of embolus a medium-sized hook.

VARIATIONS.—The number of spines on the ventral surface of tibia I in many specimens is reduced to 2-2, there being no distal spines, but these are replaced by long hairs or bristles; when the preceding is the case there are three instead of two lateral spines; the color of the abdomen varies greatly in both sexes; the visibility of the parts of the epigynum depends entirely on the relative impregnation of chitin of the internal structures and the exoskeleton.

TYPE LOCALITY.—Colorado (Simon). Type specimen probably in Museum National d'Histoire Naturelle.

DISTRIBUTION.—Colorado: Denver (W. G. Dietz); Pikes Peak Canyon, July 21, 1908 (F. E. Lutz); Lump Creek, near Gilpin, Aug. 1, 1934 (H. G. Rodeck), A. M. N. H.—Idaho: Montpelier, Aug. 19, 1930 (Gertsch), A. M. N. H.—Minnesota: Plummer, Nov. 12-18, 1933 (Denning), A. M. N. H.; Itasca Park, May 29-30, 1932 (Gertsch), A. M. N. H.—Missouri: Rocheport Cave (Nathan Banks coll.), M. C. Z.—Montana: West Fork, Ravalli Co., June 10, 1934, A. M. N. H.—New Jersey: Alpine, April 25, 1909; Roselle Park, XI-20-10, A. M. N. H.—New Mexico: (cited by Chamberlin, 1933).—New York: Cornwall, May 30, 1913; Palisades on Hudson River, April 20, 1907 (A. P.); Lake Sebago, Interstate Park, Oct. 17, 1933 (Gertsch); Apulia, Oct., 1900 (Britcher), A. M. N. H.; Sea Cliff (Nathan Banks coll.) 4, 2, M. C. Z.—Ohio: Salineville (Nathan Banks coll.), M. C. Z.—Tennessee: Cumberland Gap, March 24, 1929 (Barrows), A. M. N. H.; Montvale, March 18, 1929 (W. M. Barrows); Great Smoky Mts., July 8-10, 1933 (Gertsch and Ivie), A. M. N. H.—Utah: Chamberlin (cited in 1913); Fish Lake, Sevier Co., June 22, 1930 (Gertsch), A. M. N. H.; Mirror Lake, Uintah Mts., Sept. 3, 1931 (Gertsch), A. M. N. H.—Texas: Austin, A. M. N. H.—Virginia: Falls Church (Nathan Banks coll.), M. C. Z.—Canada (Manitoba): Aweme, Oct. 16, 1917 (Criddle), A. M. N. H.

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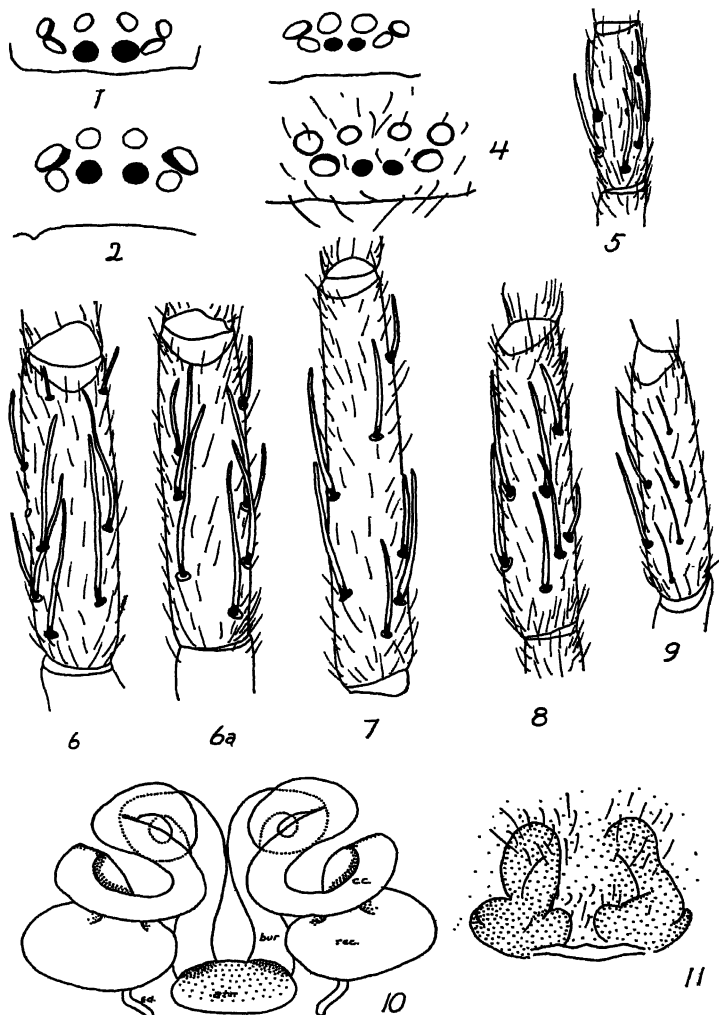


Fig. 1. *Cicurina placida* Banks, eyes.

Fig. 2. *Cicurina cicurea* Fabricius, eyes.

Fig. 3. *Cicurina brevis* Emerton, eyes.

Fig. 4. *Cicurina bryantae*, n. sp., eyes.

Fig. 5. *Cicurina brevis* Emerton, ventral view of tibia I.

Fig. 6, 6a. *Cicurina bryantae*, n. sp.; 6, ventral view of left tibia I; 6a, same for right tibia.

Fig. 7. *Cicurina cicurea* Fabricius, ventral view of tibia I.

Fig. 8. *Cicurina pusilla* Simon, ventral view of tibia I.

Fig. 9. *Cicurina placida* Banks, ventral view of tibia I.

Fig. 10. *Cicurina idahoana* Chamberlin, epigynum dissected, showing atrium (atr.), receptaculum (rec.), bursa (bur.), connecting canal (c. c.), and fertilization duct (f. d.).

Fig. 11. *Cicurina placida* Banks, external view of epigynum.



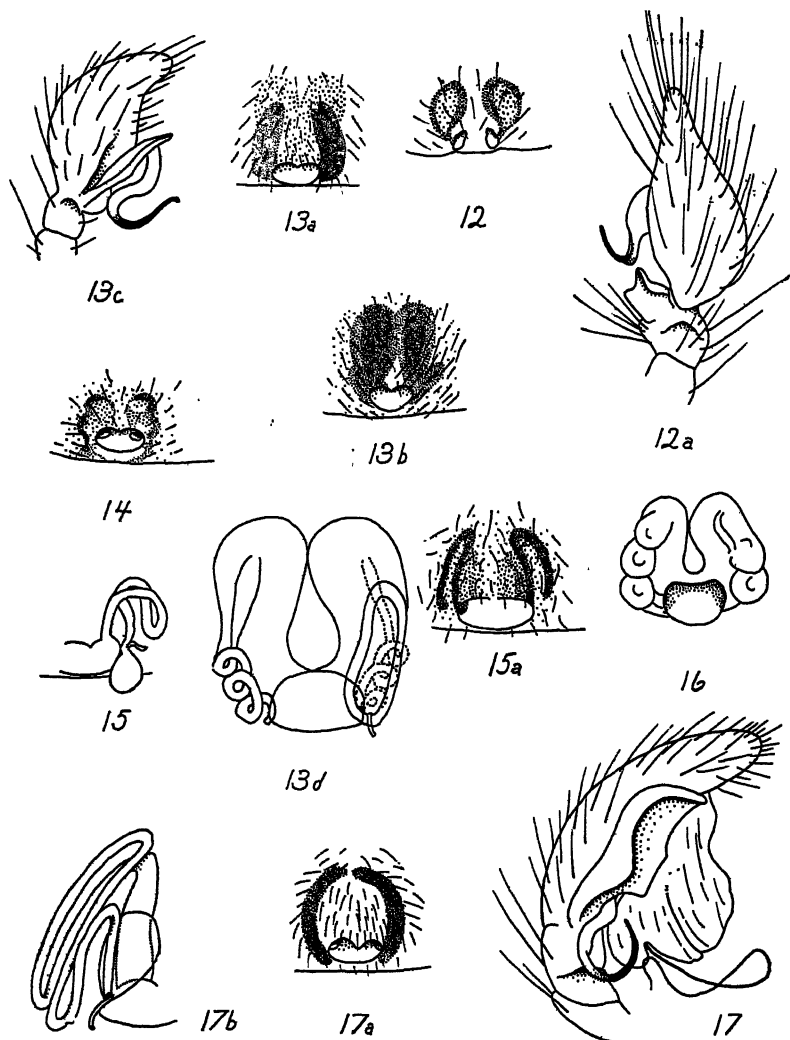


Fig. 12, 12a. *Cicurina pallida* Keyserling; 12, epigynum; 12a, palus of male.

Fig. 13a-d. *Cicurina brevis* Emerton; 13a and 13b, external views of epigyna of two different specimens; 13c, palpus of male; 13d, epigynum of female dissected, showing on the left side only the bursa and connecting canal, on the right with the receptaculum also.

Fig. 14. *Cicurina bryantae*, n. sp., epigynum of female.

Fig. 15, 15a. *Cicurina tersa* Simon; 15, one side of dissected epigynum, with receptaculum reflected posteriorly; 15a, external view of epigynum.

Fig. 16. *Cicurina cicurea* Fabricius, epigynum.

Fig. 17, 17a-b. *Cicurina pusilla* Simon; 17, palpus of male; 17a, external view of epigynum; 17b, one side of dissected epigynum.

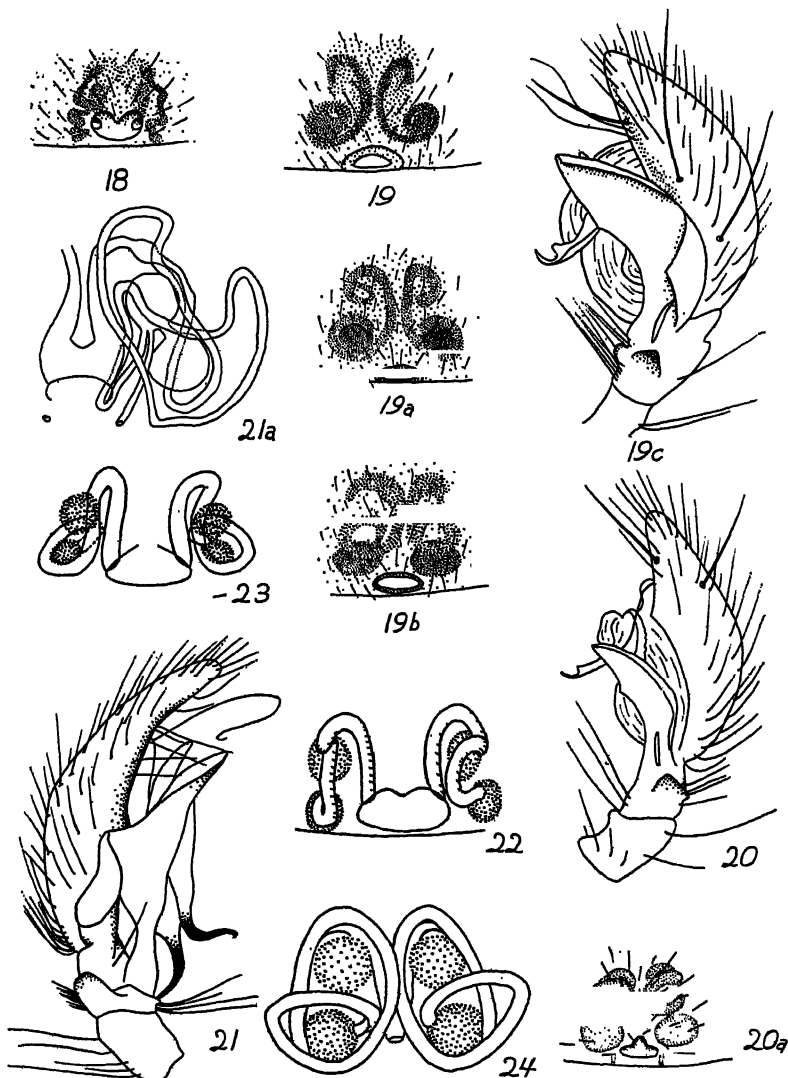


Fig. 18. *Cicurina atomaria* Simon, epigynum.

Fig. 19, 19a-c. *Cicurina simplex* Simon; 19, 19a, and 19b, external views of the epigynum of three different specimens; 19c, palpus of male.

Fig. 20, 20a. *Cicurina idahoana* Chamberlin; 20, palpus of male; 20a, external view of epigynum.

Fig. 21, 21a. *Cicurina robusta* Simon; 21, palpus of male; 21a, half of a dissected epigynum.

Fig. 22. *Cicurina gertschi*, epigynum.

Fig. 23. *Cicurina schulzi*, epigynum.

Fig. 24. *Cicurina davisi*, epigynum.



# AMERICAN MUSEUM NOVITATES

Number 851

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

May 22, 1936

## DIAGNOSES OF NEW SOUTHERN SPIDERS

By W. J. GERTSCH AND S. MULAİK

The species described as new in the following pages were collected for the most part by the junior author in southern Texas. The new genus *Argennina* is established for a spider allied to *Argenna* in the Dictynidae, and the genus *Neoanagraphis* for a gnaphosid from New Mexico that presents various unusual characters. The types of all the species are deposited in the collection of The American Museum of Natural History.

### Dictynidae

#### *Tricholathys knulli*, new species

##### Figure 1

FEMALE.—Total length, 3.5 mm. Carapace, 1.25 mm. long, 0.85 mm. wide.

Carapace dark reddish brown, somewhat infuscated and streaked with black on the sides, clothed with a few erect black hairs. Sternum infuscated, with a black marginal seam. Mouth parts and coxae pale yellowish brown, the whole underside sparsely clothed with black hairs. Legs dusky yellowish brown, immaculate. Dorsum of abdomen gray, with indistinct pale chevrons and spots in the caudal half, the venter paler.

Carapace longer than broad, the thoracic portion oval in outline, strongly convex, the pars cephalica somewhat elevated, convex, the sutures virtually obsolete. Width of the front three-fourths the greatest width (0.64 mm./0.85 mm.). Clypeus three-fourths as high as the diameter of an anterior median eye. Eyes of the first row slightly procurved, slightly recurved as seen from above, the medians separated by a radius, half as far from the larger laterals. Eyes of the second row very weakly procurved, virtually straight, the medians separated by their diameter, as far from the subequal laterals. Median ocular quadrangle broader than long (20/17), narrowed in front (20/16), the anterior medians smaller. Chelicera with four small teeth on the lower margin. Sternum longer than broad (75/56), cordate, truncate in front, weakly rounded on the sides, bluntly pointed between the posterior coxae which are separated by half their width. Labium longer than broad (27/23). First two legs unspined. Third and fourth tibiae with a distal ventral pair, the metatarsi with two pairs of ventral spines. Epigynum as figured.

TYPE LOCALITY.—Female holotype from Brownsville, Texas, taken June 1, 1924, by J. N. Knull.

*Argenna monticola*, new species

## Figure 2

FEMALE.—Total length, 1.95 mm. Carapace, 0.80 mm. long, 0.64 mm. wide.

Carapace dusky yellow in color, the eyes enclosing a black field, very sparsely supplied with inconspicuous pale hairs. Carapace, mouth parts and appendages pale immaculate yellow, clothed sparsely with fine black hairs. Abdomen gray to pale yellow, the dorsum infuscated, sparsely clothed with black hairs.

Carapace longer than broad, the thoracic portion suborbicular in outline, moderately convex, the pars cephalica elevated, more strongly convex, the front gently rounded, highest behind the posterior eyes. Width of the front more than half the greatest width of the carapace (0.35 mm./0.64 mm.). Eyes of the first row straight, slightly recurved as viewed from above, the medians separated by one-third their diameter, as far from the much larger laterals. Eyes of the second row straight, the medians their diameter apart, slightly nearer the slightly larger laterals. Median ocular quadrangle broader than long (17/14), narrowed in front (16/11), the anterior eyes much smaller. Clypeus a little higher than the diameter of an anterior median eye. Chelicerae with three small teeth on the lower margins. Sternum longer than broad (50/47), cordate, truncated in front, rounded on the sides, bluntly pointed between the posterior coxae which are separated by their width. Labium broader than long (17/9). Legs without spines. Epigynum as figured.

TYPE LOCALITY.—Female holotype from Scott Able Canyon, Otero County, New Mexico, taken in July, 1934, by Mr. Stanley Mulaik.

## ARGENNINA, NEW GENUS

Carapace much longer than broad, subquadrangular, the sutures virtually obsolete. Eyes of the first row straight, the medians much smaller and nearer the laterals. Eyes of the second row straight, the medians nearer the laterals. Median ocular quadrangle broader than long, the anterior eyes much smaller. Chelicerae with two teeth on the lower margin of the furrow. Sternum and labium longer than broad. Spines weak, the first tibiae without ventral spines.

GENOTYPE.—*Argennina unica*, new species.

This genus is distinct from *Argenna* in the much lower, narrower carapace, the longer than broad labium and the long, cylindrical abdomen.

*Argennina unica*, new species

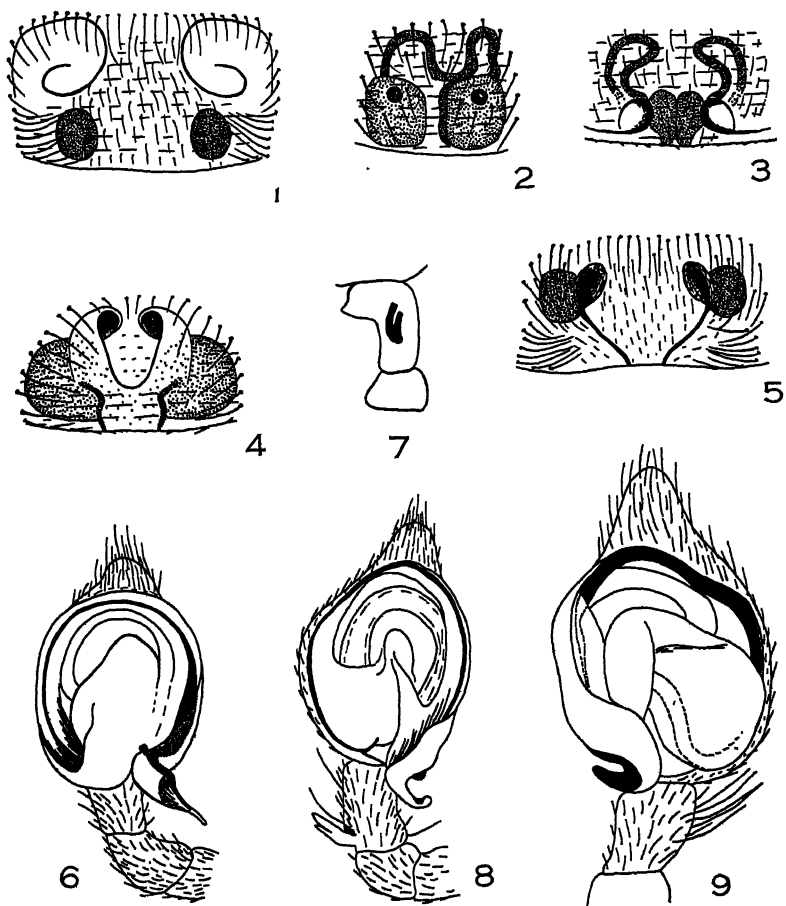
## Figure 5

FEMALE.—Total length, 5.00 mm. Carapace, 1.20 mm. long, 0.80 mm. wide.

Carapace pale yellowish brown, somewhat darker in front, sparsely covered with short inconspicuous black hairs. Eyes enclosing a black field. Labium, endites and chelicerae pale brown, the sternum and coxae lighter in color, all sparsely clothed with black hairs. Legs dull yellowish brown, immaculate, more thickly clothed with pale hairs. Abdomen gray to pale yellow, evenly but sparsely covered with pale hairs.

Carapace much longer than broad, weakly rounded behind and in front, the sides weakly rounded, the width at the front two-thirds the greatest width (28/40). Pars cephalica indistinctly separated from the thoracic part, evenly convex, the

cephalic sutures obsolete, the median suture longitudinal but difficult to see. Eyes of the first row straight from in front, very weakly procurved as viewed from above, the medians separated by four-fifths their diameter, half as far from the much larger laterals. Eyes of the second row very slightly recurved, virtually straight, the



- Fig. 1. *Tricholathys knulli*, new species, epigynum.  
 Fig. 2. *Argenna monticola*, new species, epigynum.  
 Fig. 3. *Dictyna personata*, new species, epigynum.  
 Fig. 4. *Scotolathys delicatulus*, new species, epigynum.  
 Fig. 5. *Argennina unica*, new species, epigynum.  
 Fig. 6. *Dictyna iviei*, new species, palp, ventral view.  
 Fig. 7. *Dictyna iviei*, new species, tibia of palp, dorsal view.  
 Fig. 8. *Dictyna annexa*, new species, palp, ventral view.  
 Fig. 9. *Dictyna stulta*, new species, palp, ventral view.

medians separated by two-thirds their diameter, half as far from the subequal laterals. Median ocular quadrangle broader than long (20/16), narrowed in front (20/14), the anterior medians much smaller. Clypeus two-thirds as high as the diameter of an anterior median eye. Chelicera with two teeth on the lower margins of the furrow. Sternum longer than broad (70/60), suborbicular, somewhat truncated in front, bluntly pointed between the posterior coxae which are separated by nearly their width. Labium longer than broad (25/22), five-eighths as high as the endites. First leg unspined except for a small submedian and a distal beneath the metatarsus. Tibia of second leg with two weak prolaterals and two single ventrals; the metatarsus with three single ventral spines, one of which is apical. Tibia of the fourth leg with three or four weak dorsals, two single prolateral and retrolateral, and a single and one pair beneath; the metatarsus with two dorsals, two prolaterals, two retrolaterals and three ventral pairs, the last of which is apical. Epigynum as figured. Abdomen twice as long as broad, cylindrical.

**TYPE LOCALITY.**—Female holotype from Edinburg, Texas, Spring, 1933, collected by Mr. Stanley Mulaik.

*Scotolathys delicatulus*, new species

Figure 4

**FEMALE.**—Total length, 1.80 mm. Carapace, 0.70 mm. long, 0.54 mm. wide. Abdomen, 1.05 mm. long, 0.80 mm. wide.

Carapace pale yellowish brown, immaculate, the eyes ringed in black. Mouth parts and appendages concolorous with the carapace. Abdomen gray, with indistinct black chevrons above, the venter pale.

Carapace with a median line of bristles, otherwise provided with only a few hairs. Appendages and abdomen clothed more thickly with black hairs. Eyes usually six, the anterior medians lacking or in some specimens very minute. Eyes of the second row procurved, the medians separated by two-thirds their diameter, one-third as far from the very slightly larger lateral eyes. Posterior lateral eyes subcontiguous with the anterior laterals, forming a recurved line with them. The anterior eyes separated by two-thirds their diameter. Quadrangle of anterior laterals and posterior medians broader than long (20/16), narrowed behind in the same ratio, the anterior eyes larger. Clypeus as high as one-fifth the diameter of an anterior eye. Sternum longer than broad (47/37), bluntly rounded behind and separating the posterior coxae by their length. Labium broader than long (14/11), half as high as the endites (11/20). Epigynum as figured.

**TYPE LOCALITY.**—Female holotype from fifteen miles southwest of Harlingen, Texas, taken November 18, 1934, by Mr. Stanley Mulaik. Two female paratypes from thirty-two miles east of Laredo, Texas, February 9, 1935 (S. Mulaik). Two female paratypes from seven miles east of Edinburg, Texas, February 17, 1935 (S. Mulaik).

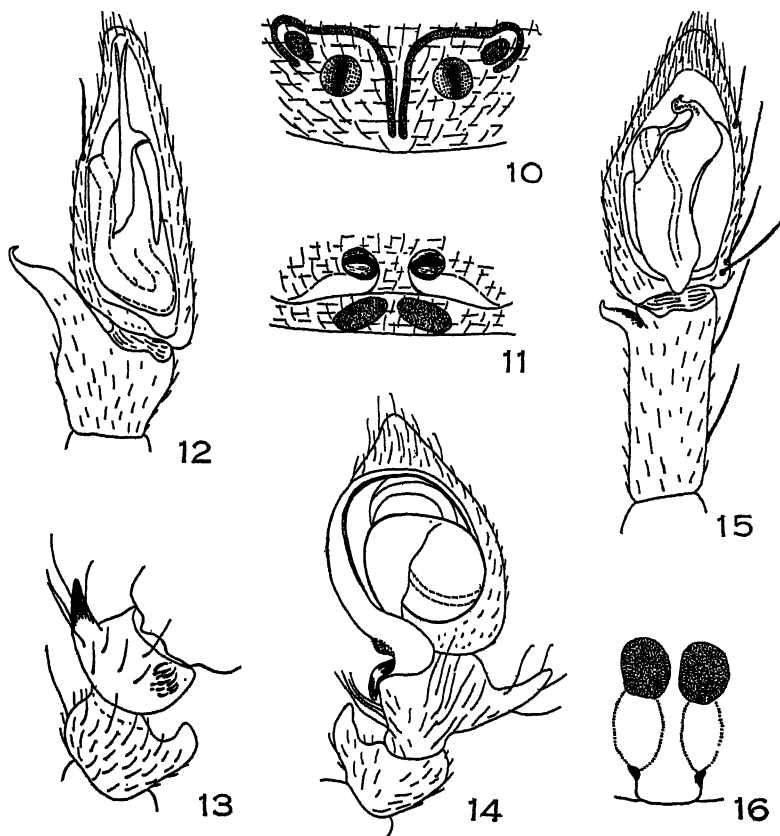
*Dictyna segregata*, new species

Figures 13 and 14

**MALE.**—Total length, 1.80 mm. Carapace, 0.83 mm. long, 0.73 mm. wide. Total length of a paratype, 2.10 mm.

Carapace dark brown to black, paler on the head portion and with lighter streaks on the pars thoracica, clothed sparsely with white hairs. Sternum and mouth parts black, covered with inconspicuous fine white hairs. Coxae and legs pale yellow, the femora, tibiae and metatarsi with submedian and distal annulae, the patellae with a single dark ring. Dorsum of abdomen mainly black, with a median longitudinal light band made up of indistinct white chevrons. Venter nearly black, with short white bands on the sides.

Carapace longer than broad, the thoracic part suborbicular in outline, somewhat convex, the pars cephalica strongly elevated, very convex, highest behind the ocular



- Fig. 10. *Dictyna provida*, new species, epigynum.  
Fig. 11. *Dictyna declarata*, new species, epigynum.  
Fig. 12. *Cesonia sincera*, new species, palpus, ventral view.  
Fig. 13. *Dictyna segregata*, new species, patella and tibia of palpus, dorsal view.  
Fig. 14. *Dictyna segregata*, new species, palpus, ventral view.  
Fig. 15. *Neonanagraphis chamberlini*, new species, palpus, ventral view.  
Fig. 16. *Cesonia sincera*, new species, epigynum.



area, the front weakly rounded, the sutures virtually obsolete. Clypeus sloping, one and one-half times as high as the diameter of an anterior median eye. Eyes of the first row very weakly procurved as seen from in front, recurved from above, the medians separated by their diameter, scarcely half as far from the slightly larger laterals. Eyes of the posterior row straight, the medians separated by scarcely a diameter, fully a diameter from the subequal laterals. Median ocular quadrangle broader than long (20/16), slightly narrower in front (20/17), the posterior eyes larger. Sternum longer than broad (53/49), truncated in front, rounded on the sides, bluntly pointed between the posterior coxae which are separated by their width. Labium broader than long (18/16). Chelicerae bent, moderately excavated on the inner side. Tibia and patella of the first leg longer than the carapace (1.05 mm.). Patella of the male palpus with a short blunt retrolateral apophysis. Tibia with a prolateral spur, the joint otherwise normal. Palpal details as figured.

FEMALE.—Total length, 2.55 mm. Color and general structure as in the male but the pattern on the abdomen less distinct. Pars cephalica lower than in the male, evenly convex. Eyes of the second row smaller proportionately, the medians separated by one and one-fourth their diameter, as far from the laterals. Epigynum as figured.

TYPE LOCALITY.—Male holotype and female allotype and paratypes from northwest of Edinburg, Texas, taken June 15, 1935, by Mr. Stanley Mulaik. Female paratype from Edinburg, Texas, June 2, 1935 (Mulaik). Female paratypes from Edinburg, February 10, 1935 (Mulaik). Male paratype from Edinburg, September 15, 1935 (Mulaik). Female paratype from Brownsville, December 1, 1934 (Mulaik). Male and female paratypes from two miles south of McCook, Texas, June 28, 1935 (Mulaik).

This interesting species is closely related to *Dictyna mulegensis* Chamberlin, first described from Lower California, which is common in southern Texas. In the male the tibia of the palpus is normal on the retrolateral side, but in *mulegensis* there is a pronounced excavation at the base, leaving a rounded retrolateral lobe. In *mulegensis* the carapace is much lighter and the abdomen is marked with small black spots on a pale ground.

### *Dictyna annexa*, new species

Figure 8

MALE.—Total length, 1.95 mm. Carapace, 0.88 mm. long, 0.72 mm. wide. Abdomen, 1.10 mm. long, 0.78 mm. wide.

Carapace uniform light brown, the margins with a very narrow dark seam. Sternum pale brown, margined with black, the mouth parts concolorous. Legs uniform pale yellow to white. Dorsum of the abdomen mainly white with a black hastate marking in the basal half and three pairs of spots behind. Venter pale in the middle.

Carapace provided with several rows of bristles on the dorsum, highest just behind the eyes, the caudal declivity abrupt. Eyes of the first row straight from

in front, slightly procurved as viewed from above, the medians separated by scarcely their diameter, half as far from the lateral eyes. Second row of eyes slightly recurved, the medians separated by one and one-fourth their diameter, as far from the lateral eyes. Median ocular quadrangle as broad as long, slightly narrowed in front, the eyes subequal in size. Sternum longer than broad (53/44), bluntly rounded between the posterior coxae which are separated by their width. Labium longer than broad (24/20). Legs without spines. Chelicerae bent, moderately excavated on the inner side. Tibia and patella of the first leg longer than the carapace (1.10 mm.). Tibia of the palpus with a short dorsal spur near the base. Details of the palpus as figured.

**TYPE LOCALITY.**—Male holotype from five miles west of Edinburg, Texas, taken July 4, 1935, by Mr. Stanley Mulaik.

*Dictyna iviei*, new species

Figures 6 and 7

**MALE.**—Total length, 1.74 mm. Carapace, 0.76 mm. long, 0.58 mm. wide.

Integument of the carapace pale yellow to white in the freshly moulted example, the margins with a narrow reddish seam, the dorsum heavily suffused with reddish brown, without distinct pattern. Mouth parts and sternum pink, the legs pale yellow, tinged with pink. Abdomen gray to pale yellow above, rather evenly flecked with small black markings, the sides more heavily maculate in black, the venter pale.

Carapace longer than broad, moderately high, the convex pars thoracica suborbicular in outline, the pars cephalica higher, more strongly convex, gently sloping caudad. Cervical groove and striae practically obsolete. Sternum cordate, longer than broad (46/38), pointed behind between the fourth coxae which are separated by two-thirds their width. Labium as long as broad. Tibia and patella of the first leg shorter than the carapace (0.70 mm.). Eyes of the first row very slightly recurved as seen from in front, the medians separated by a diameter, half as far from the larger laterals. Second row of eyes very weakly recurved, the medians separated by one and one-half times their diameter, as far from the slightly larger laterals. Median ocular quadrangle as broad as long, slightly narrowed in front, the anterior eyes smaller. Clypeus as high as the diameter of an anterior lateral eye. Tibia of palpus with a very short dorsal spur near the base. Details of palpus as figured.

**TYPE LOCALITY.**—Male holotype from Edinburg, Texas, May 2, 1935, collected by Mr. Stanley Mulaik.

*Dictyna stulta*, new species

Figure 9

**MALE.**—Total length, 2.00 mm. Carapace, 1.00 mm. long, 0.80 mm. wide.

Carapace bright reddish brown, slightly darkened on the sides of the head, apparently once sparsely covered with pale hairs. Eyes narrowly ringed in black. Sternum and mouth parts bright reddish brown, the legs immaculate, paler than the sternum, the clothing for the most part rubbed off but with a few inconspicuous pale hairs yet present. Abdomen light reddish brown, the dorsum and sides somewhat infuscated, the venter paler.

Carapace longer than broad, the outline of the pars thoracica suborbicular,

moderately convex, the head portion strongly elevated, weakly rounded in front, highest just behind the eye region, the sutures indistinct. Clypeus sloping, twice as high as the diameter of an anterior median eye. Eyes of the first row practically straight as seen from in front, recurved from above, the medians separated by two-thirds their diameter, half as far from the slightly larger laterals. Eyes of the posterior row very weakly recurved, the medians separated by scarcely their diameter, fully a diameter from the laterals. Median ocular quadrangle broader than long (18/16), as wide in front as behind, the posterior medians slightly larger. Chelicerae slightly bent, moderately excavated on the inner side. Sternum longer than broad (60/55), truncated in front, moderately rounded on the sides, rather broadly rounded behind between the posterior coxae, which are separated by their length. Labium as broad as long (0.20 mm./0.20 mm.). Tibia and patella of the first leg longer than the carapace (1.10 mm.). Tibia of the palpus with a very short dorsal spur near the base. Details of the palpus as figured.

TYPE LOCALITY.—Male holotype from Jeff Davis County, Texas, taken in July, 1934, by Mr. Stanley Mulaik.

This species is closely related to *Dictyna uirtana* Chamberlin and *D. brevitarsus* Emerton. It is distinct from *uirtana* in lacking the prominent spurs at the base of the chelicerae. From *brevitarsus* it may be distinguished by the uniform bright color, by the less pronounced retro-lateral distal lobe on the tibia of the palpus and in the details of the palpus.

### *Dictyna provida*, new species

Figure 10

FEMALE.—Total length, 1.10 mm. Carapace, 0.50 mm. long, 0.40 mm. wide.

Carapace pale brown, the margin with a black seam, the pars thoracica with radiating black streaks which go forward to the lateral eye of each side. Sides of the pars cephalica infuscated. Sternum and mouth parts infuscated. Coxae and legs pale yellow except the femora, which are black, and a black ring at the base of each tibia. Legs clothed with pale hairs. Abdomen mainly black, with a median longitudinal pale band made up of spots on the dorsum, the venter irregularly maculate in black.

Carapace longer than broad, the pars thoracica convex, suborbicular in outline, the head portion elevated, highest just behind the eyes, the front weakly rounded. Sutures obsolete. Clypeus as high as the diameter of an anterior median eye. Eyes of the first row straight from in front, recurved as viewed from above, the medians separated by one-third their diameter, half as far from the larger laterals. Eyes of the second row weakly recurved, the medians separated by two-thirds their diameter, as far from the equal laterals. Median ocular quadrangle broader than long (12/11), slightly narrowed in front, the posterior eyes considerably larger. Sternum longer than broad (35/30), truncated in front, broadly rounded on the sides, bluntly pointed between the posterior coxae, which are separated by their length. Labium broader than long (13/9). Tibia and patella of the first leg shorter than the carapace (0.46 mm.). Epigynum as figured.

**TYPE LOCALITY.**—Female holotype and paratypes from Edinburg, Texas, taken May 2, 1935, by Mr. Stanley Mulaik. Two female paratypes from Monte Cristo, Hidalgo County, Texas, September 10, 1935 (Mulaik).

The small size, the black femora and the details of the epigynum will separate this species from any heretofore described from the United States.

*Dictyna declarata*, new species

Figure 11

**FEMALE.**—Total length, 3.10 mm. Carapace, 1.20 mm. long, 0.95 mm. wide.

Carapace dull yellow, darkened slightly on the sides of the pars cephalica, clothed sparsely with long white hairs, the eyes narrowly ringed in black. Mouth parts, sternum and chelicerae dull yellowish brown, the sternum with an inconspicuous black median marking, clothed with pale hairs. Legs concolorous with the carapace, immaculate except for very faint, narrow dark annulae at the distal end of the tibiae and metatarsi. Abdomen mainly white, reticulate in gray, clothed evenly with pale hairs.

Carapace longer than broad, convex, the pars cephalica higher, more strongly convex, the sutures feebly defined. Eyes of the first row straight from in front, the medians separated by two-thirds their diameter, half as far from the slightly smaller laterals. Eyes of the second row very weakly recurved, the medians separated by their diameter, as far from the slightly smaller laterals. Median ocular quadrangle as broad as long, the eyes subequal. Sternum longer than broad (70/64), bluntly pointed behind where the posterior coxae are separated by their width. Labium broader than long (22/20). Legs without spines. Epigynum as figured.

**TYPE LOCALITY.**—Female holotype and paratype from thirty miles southeast of Laredo, Texas, taken August 4, 1935, by Mr. Stanley Mulaik.

*Dictyna personata*, new species

Figure 3

**FEMALE.**—Total length, 2.05 mm. Carapace, 0.75 mm. long, 0.55 mm. wide.

Carapace pale yellow at base, the margins with a black seam, the sides with two irregular black bands that begin at the side of the head and enlarge as they pass back nearly to the margin. Eyes narrowly ringed with black. Labium, endites and coxae pale yellow, unmarked, the sternum pale yellow, with a narrow black marginal seam, all sparsely clothed with pale hairs. Chelicerae dull brown. Legs pale, dull yellow, with incomplete annulae at the middle of the femora and at the base and distal end of the tibiae, the legs sparsely clothed with inconspicuous black hairs. Abdomen mainly white, reticulate in gray, with a basal black spot and a side row of black spots on the dorsum, the venter pale.

Carapace longer than broad, convex, the pars cephalica somewhat higher, more convex, the sutures obsolete. Eyes of the first row straight from in front, recurved as seen from above, the medians separated by one-third their diameter, scarcely as

far from the slightly larger laterals. Eyes of the second row very weakly recurved, the medians separated by two-thirds their diameter, as far from the slightly smaller laterals. Median ocular quadrangle as broad as long, narrowed in front (12/16), the posterior eyes larger. Clypeus slightly higher than the diameter of an anterior median eye. Sternum as broad as long, cordate, bluntly pointed behind, the posterior coxae separated by their width. Labium broader than long (18/14). Legs without spines. Epigynum as figured.

TYPE LOCALITY.—Female holotype from thirty miles southeast of Laredo, Texas, August 4, 1935 (Stanley Mulaik).

### Gnaphosidae

#### *Cesonia sincera*, new species

Figures 12 and 16

MALE.—Total length, 3.20 mm. Carapace, 1.40 mm. long, 1.10 mm. wide. Abdomen, 1.85 mm. long, 1.10 mm. wide.

Carapace pale yellow, the margins with a narrow black seam, the dorsum with two longitudinal black stripes that begin at the side of the posterior lateral eyes and run the length of the carapace. Eyes ringed in black. Mouth parts, sternum and legs pale yellow. Dorsum of abdomen nearly white, marked by two longitudinal black stripes, the interval between forming a white band. Sides of the abdomen with a black stripe. Venter white, unmarked. Carapace and abdomen clothed with white or black hairs that are restricted to the respective stripes.

Eyes of the first row slightly procurved as seen from in front, appearing recurved from above, the anterior medians separated by one-third their diameters, subcontiguous with the subequal laterals. Second row of eyes very weakly procurved, the oval medians separated by one diameter, subcontiguous with the subequal laterals. Median ocular quadrangle slightly longer than broad (20/18), narrowed in front (15/18), the eyes subequal. Clypeus slightly higher than the diameter of an anterior median eye. Chelicera with a single small tooth on the lower margin. Sternum slightly longer than broad (0.85 mm./0.70 mm.). Labium slightly longer than broad (18/16). First leg spined as follows: femur, dorsal, 1-1-1, prolateral, 1, distal, tibia, ventral, 1-1-2, metatarsus, ventral, 1 basal. Second leg as first. Third leg as first but the femur, retrolateral, and prolateral, 1-1, tibia, prolateral and retrolateral, 1 distal, ventral, 1 distal pair, metatarsus, dorsal, 2, prolateral and retrolateral, 1, ventral, 2. Metatarsi and tarsi of first two pairs scopulate throughout their length. Tarsi of the last two pairs scopulate at the distal end. Palpus as figured.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.05	0.61	0.73	0.70	0.52	3.61 mm.
II	1.05	0.60	0.70	0.68	0.54	3.57 mm.
III	0.90	0.44	0.62	0.58	0.52	3.06 mm.
IV	1.25	0.65	0.96	1.30	0.66	4.82 mm.

FEMALE.—Total length, 6.30 mm. Color and structure as in the male. Epigynum as figured, the receptacles subcontiguous, not well separated as in *Cesonia bilineata* (Hentz).

TYPE LOCALITY.—Male holotype from Rio Grande City, Starr County, Texas, taken July, 1934, by Mr. Stanley Mulaik. Female allotype from Edinburg, Texas, June, 1933 (S. Mulaik). Two female paratypes from Edinburg, May 2, 1935 (S. Mulaik). Two female paratypes from Edinburg, Texas, March–April, 1934 (S. Mulaik). Female paratype from northwest of Edinburg, Texas, September 3, 1934 (S. Mulaik), in the collection of the University of Utah. Two female paratypes from southwest Hidalgo County, Texas, July 2, 1934 (S. Mulaik).

#### NEOANAGRAPHIS, NEW GENUS

A genus of the subfamily Drassodinae. Lower margin of the furrow of the chelicera with two teeth, the upper with three. Posterior eye row weakly recurved, the eyes equidistant. Fourth tibia with two single dorsal spines. Eyes near together, the laterals separated by less than their diameter. Labium scarcely as long as broad, half as high as the endites. Sternum as broad as long. Leg formula, 4132, the tibiae with 2–2–2 ventral spines, the tarsal claws very long, with a few teeth near the base.

GENOTYPE.—*Neoanagraphis chamberlini*, new species.

This genus runs to *Rachodrassus* Chamberlin in the key to the North American genera but is distinct in the recurved posterior eye row, the subequal eyes of the first row, the structure of the tarsal claws, and the small size of the tibial apophysis of the male palpus.

#### *Neoanagraphis chamberlini*, new species

##### Figure 15

MALE.—Total length, 8.50 mm. Carapace, 4.00 mm. long, 3.20 mm. wide.

Carapace yellow to light yellowish brown, darkened somewhat in the head region, the eyes ringed in black. Chelicerae reddish brown. Legs concolorous with the carapace. Abdomen gray to dull yellow.

Carapace longer than broad, relatively low, convex, the median suture a deep longitudinal groove. Pars cephalica at the front half as wide as the greatest width of the carapace (152/320). Clypeus as high as the diameter of an anterior lateral eye. Eyes of the first row straight, slightly recurved as seen from above, subcontiguous, the medians very slightly larger. Second row of eyes recurved, a line through the centers of the laterals cutting the posterior margins of the medians, the eyes subequal in size and subequidistantly spaced. Median ocular quadrangle slightly broader than long (46/44), narrowed in front (46/38), the anterior medians slightly larger. Sternum as long as broad, suborbiculate, the posterior coxae contiguous. Labium slightly broader than long (57/51), broadly rounded at the tip, half as high as the parallel endites. Chelicerae with two stout teeth on the lower margin, three on the upper.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	4.48	1.80	4.30	4.47	2.50	17.55 mm.
II	4.46	1.70	4.20	4.30	2.25	16.91 mm.
III	4.46	1.70	3.80	5.00	2.45	17.41 mm.
IV	5.35	1.80	4.70	6.50	2.80	20.85 mm.

Metatarsi and tarsi of the first two legs and the tarsi only of the last two pairs scopulate beneath. All tibiae with 2-2-2 ventral spines, the distal pair weak, 1-1-1 prolaterals and 1-1-1 retrolaterals. Last two tibiae with two dorsal spines. All tarsi flexible, with a series of false sutures in the distal half of the joint. Claws similar, very long, with nine short teeth at the base. Palpus as figured.

TYPE LOCALITY.—Male holotype from White Sands, New Mexico, taken in August, 1934, by Mr. Stanley Mulaik.

### *Liodrassus deceptus*, new species

Figures 22, 23 and 24

MALE.—Total length, 5.50 mm. Carapace, 2.65 mm. long, 1.70 mm. wide.

Carapace light yellowish brown, sparsely clothed with black hairs, the eyes enclosing a black field. Under parts and legs concolorous, clothed with black hairs, the metatarsus and tarsus of the first leg and the tarsus of the palpus dark brown. Abdomen dull black, the dorsum with a shining, light brown scutum at the base that is half as long as the abdomen. Venter paler.

Carapace longer than broad, moderately high, convex, the head sutures obsolete, the median furrow longitudinal, a short groove. Width of the head at the front three-sevenths of the total width. Eyes of the first row procurved, recurved as seen from above, the medians separated by three-fifths their diameter, contiguous with the smaller laterals. Eyes of the second row straight, the medians separated by two-thirds their diameter, scarcely as far from the subequal laterals. Median ocular quadrangle as broad as long, wider in front (40/36), the anterior medians much larger. Lower margin of the furrow of the chelicera unarmed, the upper with a long, low keel. Clypeus equal in height to the diameter of an anterior lateral eye. Sternum much longer than broad (16/9), weakly rounded on the sides, pointed behind, the posterior coxae subcontiguous. Labium longer than broad (40/32). Spines of the first leg as follows: femur, dorsal, 3, prolateral, 1; tibia, ventral, 1 distal pair; metatarsus, ventral, 1 basal pair; elsewhere none. Second leg as the first but tibia, ventral, 0-1-2. Third and fourth tibiae unarmed above, with 1-2-2 and 2-2-2 ventral spines, respectively; the same metatarsi with 2-2 and 2-2-2 ventral spines, respectively, the last pair in each case distal. Tibia and patella of the first leg, 2.25 mm.; of the fourth leg, 2.45 mm. long. Palpus as figured.

FEMALE.—Total length, 6.50 mm. Carapace and appendages dark reddish brown in color, clothed with black hairs. Abdomen uniform dull black, lacking a scutum, evenly covered with gray hairs. Structure as in the male but the posterior row of eyes gently procurved. Epigynum as figured.

TYPE LOCALITY.—Male holotype from fifteen miles southwest of Harlingen, Texas, taken November 18, 1934, by Mr. Stanley Mulaik. Female allotype from Edinburg, Texas, May 2, 1935 (S. Mulaik).

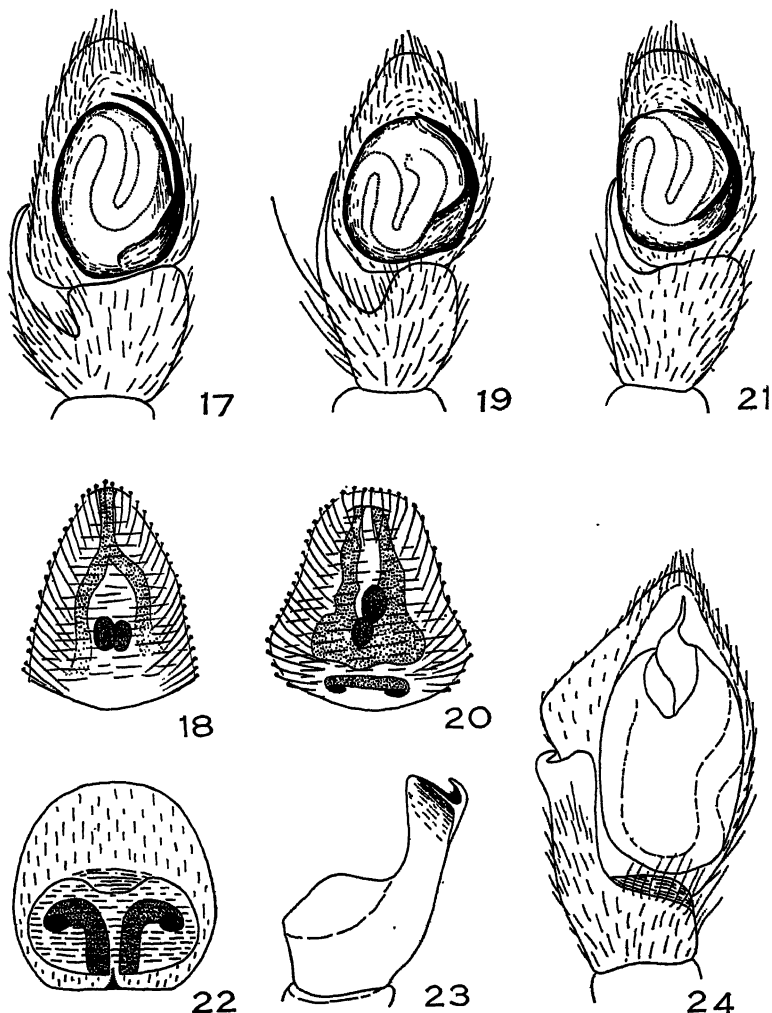


Fig. 17. *Sitticus callidus*, new species, palpus, ventral view.

Fig. 18. *Sitticus callidus*, new species, epigynum.

Fig. 19. *Sitticus absolutus*, new species, palpus, ventral view.

Fig. 20. *Sitticus absolutus*, new species, epigynum.

Fig. 21. *Sitticus floridanus*, new species, palpus, ventral view.

Fig. 22. *Liodrassus deceptus*, new species, epigynum.

Fig. 23. *Liodrassus deceptus*, new species, tibia of palp, dorsal view.

Fig. 24. *Liodrassus deceptus*, new species, palpus, ventral view.



Female paratype from Edinburg, October, 1934 (S. Mulaik). Male paratype from Edinburg, Texas, in the collection of the University of Utah.

### Salticidae

#### *Corythalia delicatula*, new species

##### Figure 32

**FEMALE.**—Total length, 2.55 mm. Carapace, 1.10 mm. long, 0.85 mm. wide.

Carapace all black, smooth and shining, rubbed but apparently sparsely clothed with inconspicuous dark hairs. Sternum, labium and coxae brown, sparsely clothed with black hairs. Legs bright brown, with brown hairs. Abdomen black, shining, the dorsum with a transverse white stripe near the base, an inverted triangular white stripe at the middle and two short longitudinal white stripes close together in the caudal half. Venter of the abdomen infuscated, with a large white spot on each side.

Carapace rather high, flat in the ocular area, the sides abruptly declining, the posterior declivity moderately steep, beginning back three-fourths of the total length. Eyes of the first row slightly recurved, the upper margins forming a straight line, subcontiguous, the medians larger (24/16). Small eyes of the second row nearer the eyes of the third row than the second (10/17). Posterior row of eyes as broad as the first row, the eyes equal in size to the anterior laterals. Quadrangle of the eyes occupying three-fifths of the total length of the carapace. Clypeus very narrow, equal in height to about one-eighth of the diameter of an anterior median eye. Chelicera with a single small tooth on the lower margin. Posterior coxae contiguous. Tibia of the first leg with 2-2-2 ventral spines, the last pair not quite distal, the metatarsus with 2-2 ventral spines, the last spines subdistal. Epigynum as figured.

**TYPE LOCALITY.**—Female holotype from Brooks County, Texas, October 7, 1934, collected by Mr. Stanley Mulaik.

#### *Pellenes tuberculatus*, new species

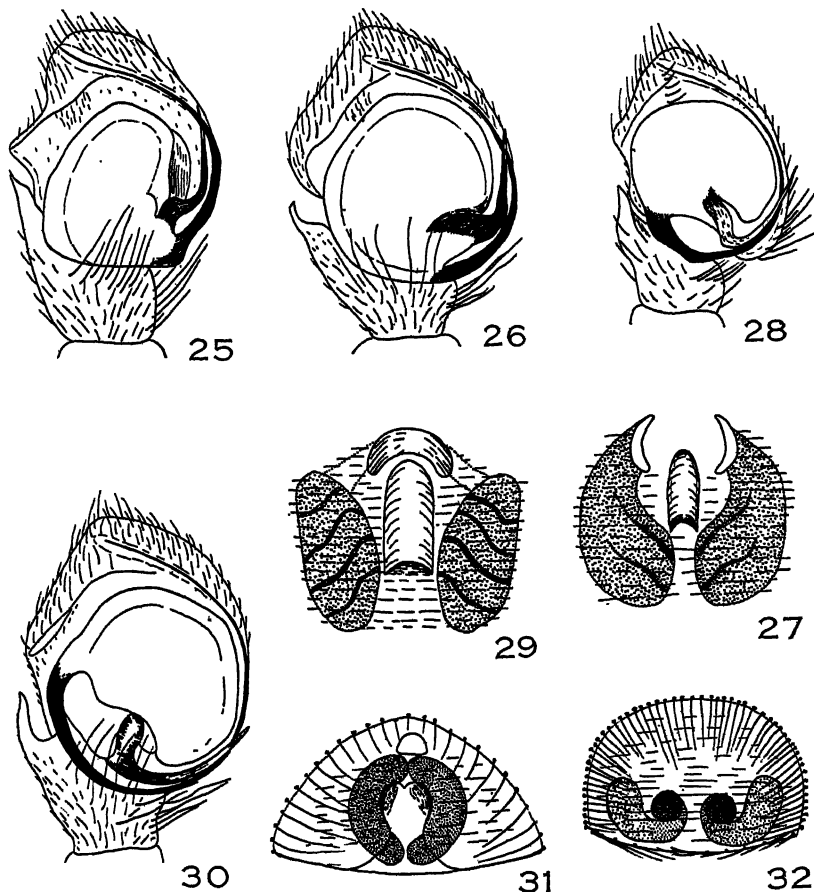
##### Figure 25

**MALE.**—Total length, 4.90 mm. Carapace, 2.30 mm. long, 1.80 mm. wide.

Integument of the carapace black, darkest in the eye region, clothed with white hairs which in life apparently covered the whole carapace. Ocular area with a heavy line of white hairs that begins between the anterior median eyes and goes back nearly to the posterior row. Clypeus pale, clothed with short tawny hairs. Sternum black, very thickly covered with white hairs. Mouth parts and coxae yellow, more sparsely clothed with white hairs. First leg brown, paler above, clothed evenly with white scales, without a conspicuous fringe. Other legs paler, with a few brown markings, sparsely clothed with white hairs. Abdomen rubbed, the integument of the dorsum black, the venter paler, clothed on the sides with white hairs.

Carapace high, heavy, moderately convex above, the sides abrupt, the posterior declivity more gradually sloping. Margins of the carapace below the eyes of the second row expanded into a distinct tubercle on each side. Clypeus three-fifths as high as the diameter of an anterior median eye. Eyes of the first row recurved,

the upper margins forming a weakly recurved line, the medians subcontiguous, separated from the smaller laterals by one-third the diameter of the latter. Small eyes of the second row midway between the first and third eye row. Eyes of the posterior row slightly broader than the first row (27/26), the eyes smaller in size than the anterior laterals. Quadrangle of the eyes occupying more than two-fifths of the total length of the carapace (20/46). Posterior coxae contiguous. First and



- Fig. 25. *Pellenes tuberculatus*, new species, palpus, ventral view.  
Fig. 26. *Pellenes moratus*, new species, palpus, ventral view.  
Fig. 27. *Pellenes moratus*, new species, epigynum.  
Fig. 28. *Pellenes dorotheae*, new species, palpus, ventral view.  
Fig. 29. *Pellenes forticulus*, new species, epigynum.  
Fig. 30. *Pellenes forticulus*, new species, palpus, ventral view.  
Fig. 31. *Sitticus welchi*, new species, epigynum.  
Fig. 32. *Corythalia delicatula*, new species, epigynum.

third legs unmodified, the tibia of the first with 2-2-2 ventral spines and 1-1-0 prolaterals. Palpus as figured.

TYPE LOCALITY.—Male holotype from Edinburg, Texas, taken by Mr. Stanley Mulaik.

*Pellenes dorotheae*, new species

Figure 28

MALE.—Total length, 3.50 mm. Carapace, 1.80 mm. long, 1.35 mm. wide.

Carapace somewhat rubbed but apparently once sparsely clothed with white scales above and on the margins. Integument mainly brown, the ocular area brown, the eyes of the first row with red hairs between them, the posterior declivity pale yellow, with a central dark band that runs back to the margin. Sides of the carapace light yellowish brown, the margin with a very narrow black seam, the clypeus light brown, rather thickly covered with white hairs. Eyes ringed in black. Sternum yellow, the margins darker, sparsely clothed with fine white hairs. Mouth parts and chelicerae dark brown. Legs light to dark brown, the first one dark, clothed with black hairs above and on the sides, the ventral surface with a thin white fringe of hairs, the first coxa paler. Other legs paler, with indistinct brown annulae clothed sparsely with light and dark hairs. Femur of palpus black with short black hairs, the patella pale yellow with light hairs, the terminal joints reddish brown with inconspicuous dark hairs. Dorsum of abdomen black, with a basal white transverse band, a broader band just behind, a median triangular white spot and two small white spots just above the spinnerets. Sides of the abdomen black, the venter pale, with three indistinct longitudinal dark bands.

Carapace longer than broad, truncated in front, high, heavy, flat above, the sides vertical, the posterior declivity steep. Clypeus half as high as the diameter of an anterior median eye. Eyes of the first row recurved, the upper margins forming a very weakly recurved line, the medians subcontiguous, also subcontiguous with the smaller laterals. Small eyes of the second row midway between the lateral eyes of the first and third rows. Posterior row of eyes slightly wider than the first row (26/25), the eyes slightly smaller than the anterior lateral eyes. Eye quadrangle occupying one-half of the total length of the carapace. Posterior coxae contiguous. First leg somewhat enlarged, the tibia with 2-2-2 ventral spines, no prolaterals, the metatarsus with 2-2 ventral spines. Third leg not modified. Palpus as figured.

FEMALE.—Total length, 4.30 mm. Color and structure essentially as in the male. Epigynum as figured.

TYPE LOCALITY.—Male holotype and female allotype from fifteen miles southwest of Harlingen, Texas, taken November 17, 1934, by Mr. Stanley Mulaik.

*Pellenes rutherfordi*, new species

MALE.—Total length, 3.40 mm. Carapace, 1.80 mm. long, 1.40 mm. wide.

Integument of the carapace light brown, heavily maculate in black. Pars cephalica with a large black maculation which includes the eye quadrangle and extends just back of the third eye row, the caudal end emarginated. Posterior declivity with a central black band that goes back to the margin. Sides of the

carapace with a submarginal black band, the margins pale brown. Clypeus brown. Pattern in general clothed with hairs of a corresponding color, but the eye region with short white hairs, which are thickest between the eyes of the anterior row. Sternum, mouth parts and coxae pale yellow, thinly clothed with white hairs. Integument of the legs pale yellow, marked in black or brown as follows: First femur with a dorsal and ventral brown maculation; the patella brown above; the terminal joints brown, clothed above with a few red hairs. The patellae and tibiae of all the legs with a ventral black stripe. Other legs with a few black markings on the basal joints above, the tibiae with a narrow basal black ring. Palpus pale yellow, except the tarsus which is covered with iridescent reddish hairs. Abdomen white or pale yellow on the sides, with a broad median longitudinal dark stripe enclosing five white spots. Venter pale yellow.

Carapace moderately high, the sides nearly vertical, the posterior declivity more gradually declining. Clypeus about half as high as the diameter of an anterior median eye. Eyes of the first row recurved, subcontiguous, the diameter of the laterals about half that of the median eyes. Eyes of the second row nearer the posterior than the anterior lateral eye (15/20). Posterior eye row very slightly wider than the first row (105/102), the eyes equal in size to the anterior laterals. Quadrangle of the anterior laterals and the posterior eyes three-fifths as long as broad. Quadrangle of the eyes occupying seven-eighths of the total length of the carapace. Posterior coxae contiguous. First and third legs unmodified, the first tibia with 1-1-2 ventral spines and one median on the prolateral surface, all normal. Palpus essentially as in *Pellenes dorotheae*, new species.

TYPE LOCALITY.—Male holotype from Edinburg, Texas, collected October 15, 1935, by Mr. Clyde Rutherford.

### *Pellenes moratus*, new species

Figures 26 and 27

MALE.—Total length, 4.55 mm. Carapace, 2.53 mm. long, 1.80 mm. wide.

Integument of the carapace yellow, the sides with a submarginal brown band and a narrow marginal yellow stripe, the posterior declivity with a short brown band that goes back to the margin. Eye quadrangle rich brown in color, the posterior margin of the maculation emarginated, with a thick bunch of white hairs above the eyes of the third row and a small white line at the small eyes of the second row, the eye area otherwise closely covered with brown hairs. Narrow marginal white band of the carapace including most of the clypeus. Sternum, mouth parts and coxae pale yellow, clothed with white hairs. Integument of the legs pale yellow, maculate as follows: first femur brown above, white below and fringed with long white hairs; first patella and tibia brown to black above, with a white stripe on the sides, darker below, the tibia ventrally covered with black hairs; distal joints of the first leg pale yellow, the tarsal scopula black. Second and fourth legs irregularly marked with brown over a pale base, sparsely clothed with white and black hairs. Femur of third leg brown above and on the prolateral side, clothed with brown hairs, the prolateral surface supplied with numerous small bunches of white scales. Tibia of the third leg with a very small distal spur. Abdomen mainly black, the dorsum with a basal transverse white band, a long white stripe on each side and a median

longitudinal white stripe that does not go much beyond the middle. Venter with a dark W-shaped marking on a pale ground.

Structure of carapace as usual in the genus, the sides nearly vertical. Eyes of the first row recurved, the large medians subcontiguous, separated from the laterals by two-fifths the diameter of the latter. Eyes of the second row nearer the posterior eyes than the anterior laterals (15/20). Posterior row of eyes as wide as the anterior row, the laterals forming a quadrangle that is broader than long (15/10). Eyes occupying two-fifths of the total length of the carapace. Posterior coxae contiguous. Tibia of the first leg with 2-2-2 ventral spines, the basal and median on the prolateral side subspatulate and nearly prolateral in position. Chelicera black on the outer side. Palpus pale yellow, clothed with white hairs, the details of structure as figured.

FEMALE.—Total length, 6.80 mm. Color pattern in general agreement with that of the male, somewhat duller, the bands on the abdomen more extensive. Legs dark brown above, paler below, clothed with a few white scales and more numerous dark hairs. Clypeus white. Chelicera with a black band on the outer side. Epigynum as figured.

TYPE LOCALITY.—Male holotype and female allotype from thirty miles west of Edinburg, Texas, taken July 4, 1935, by Mr. Stanley Mulaik. Male paratype from Rio Grande City, Texas, July, 1934 (S. Mulaik). Female paratype from thirty-two miles east of Laredo, Texas, November 11, 1934 (S. Mulaik).

#### *Pellenes forticulus*, new species

Figures 29 and 30

MALE.—Total length, 4.30 mm. Carapace, 2.30 mm. long, 1.70 mm. wide.

Integument of the carapace yellow, maculate essentially as in *Pellenes moratus*, new species. Dorsum with a large quadrangular brown maculation which covers the ocular region and goes slightly behind, the caudal margin of the marking gently recurved, not deeply emarginated or notched. Posterior declivity with a median brown maculation that begins just behind the third eye row and expands to the caudal margin. Sides with a submarginal brown band and a narrow marginal pale yellow stripe that includes the clypeus. Ocular region with rich brown hairs, without white or pale hairs. Sternum, mouth parts and coxae yellow, with white hairs. Integument of legs white to pale yellow, marked as follows: femur, patella and tibia of first leg mainly dark brown above, white below and fringed with white hairs; metatarsus and tarsus yellow, with pale hairs, the distal end of the tarsus black. Third leg mainly light brown, the basal joints fringed with brown hairs, the patella modified, twice as long as broad, with a rounded lobe at the distal end, clothed with white and brown hairs above, and with a round black spot near the middle of the prolateral surface. Tibia of the third leg with a shallow groove on the prolateral surface. Abdomen black, with a narrow white longitudinal band on each side and a white longitudinal stripe in the middle of the dorsum, the venter pale. Palpus pale yellow, clothed with white hairs.

Structure as in *Pellenes moratus*, new species. Palpus as figured. First tibia with 2-2-2 ventral spines, the basal and median on the prolateral side subspatulate, and a normal median spine on the prolateral surface.

**FEMALE.**—Total length, 5.80 mm. Color pattern resembling that of the male but the colors much duller. Carapace with the large brown maculation that covers the eye region clothed with gray hairs and a few weak erect black spines. Sides mainly pale yellowish brown, the clypeus with white hairs. Legs light yellowish brown, unmarked, the tarsal scopulae black. Abdomen mainly brown to black, with an indistinct median longitudinal pale band, without the white side bands of the male. Epigynum as figured.

**TYPE LOCALITY.**—Male holotype and female allotype from Edinburg, Texas, taken October 11, 1934, by Mr. Stanley Mulaik. Male paratype from Edinburg, Texas, November 3, 1934 (S. Mulaik). Two female paratype from Edinburg, Texas, November 11, 1934 (C. Rutherford). Male paratype from Laredo, Texas, November 10, 1934 (S. Mulaik). Male paratype from Del Rio, Texas, August, 1934 (S. Mulaik). Female paratype from Arroyo Salado, Zapato County, Texas, February 9, 1935 (S. Mulaik).

#### *Sitticus absolutus*, new species

Figures 19 and 20

**MALE.**—Total length, 2.25 mm. Carapace, 1.15 mm. long, 0.92 mm. wide.

Carapace dark reddish brown, the dorsum with a broad quadrangular black spot that includes the eye region and extends behind it a short distance. Sides of the carapace reddish brown, the margins with a narrow black seam. Posterior declivity with a pale median streak. Margins of the carapace clothed with a line of white hairs. Sides of the carapace in front and the anterior row of eyes clothed with bright red hairs. Most of the dorsum smooth, shining, without hairs. Clypeus with a few white hairs. Sternum and mouth parts light brown, clothed with white hairs. Integument of the legs yellow to light brown, the prolateral and retrolateral surfaces of the first two pairs with a large black maculation, those on the third and fourth femora reduced in size. Other joints of the legs with distal black annulae. Palpus black, the femur with a thick dorsal brush of white hairs, the patella with red hairs, the terminal joints clothed above with black hairs. Abdomen reddish brown, the dorsum with white chevrons, the sides with four white spots that are nearly contiguous with the chevrons. Venter pale yellow-brown, infuscated.

Carapace high, rather heavy, quite flat above, the sides abruptly declining, the posterior declivity steep. Eyes of the first row marginal, recurved, the medians much larger (22/15), subcontiguous, as far from the laterals. Upper margins of the eyes of the first row forming a straight line. Eyes of the second row very small, nearer the posterior eye row (10/15). Eyes of the third row broader than the first row (82/77), equal in size to the anterior laterals. Quadrangle of eyes occupying nearly one-half the total length of the carapace. Clypeus one-fourth as high as the diameter of an anterior median eye. Chelicera with a single small tooth on the lower margin of the furrow. Posterior coxae contiguous. Tibia of the first leg with 1-2-2 ventral spines and a single prolateral, the metatarsus with 2-2 spines beneath. Palpus as figured, the tarsus heavily clothed with black hairs.

**FEMALE.**—Total length, 2.95 mm. Carapace, 1.15 mm. long, 0.94 mm. wide. Color as in the male but not so bright, the eye region with white hairs and a few

red ones between the eyes of the first row. Abdomen black, with a few very small light markings. Structure essentially as in the male. Epigynum as figured.

**TYPE LOCALITY.**—Male holotype and female allotype from Kingsville, Texas, taken in October, 1934, by Mr. Stanley Mulaik. Male and female paratypes from ten miles south of Edinburg, October 20, 1934 (S. Mulaik). Female paratype from southwest Hidalgo County, Texas, July 2, 1934 (S. Mulaik). Male and female paratypes from Edinburg, October, 1934 (S. Mulaik).

*Sitticus callidus*, new species

Figures 17 and 18

**MALE.**—Total length, 2.40 mm. Carapace, 1.30 mm. long, 0.98 mm. wide.

Carapace light yellowish brown, the eye region darkened, the sides and posterior declivity infuscated, the margins with a very narrow black seam. Eye region evenly covered with decumbent white hairs, and with a few red ones between the eyes of the first row. Sides of the carapace thinly clothed with white hairs. Integument of the sternum, mouth parts and legs light yellow, sparsely clothed with white hairs. Legs annulate in black as follows: femora with two rings, the other joints with a distal ring, the rings sometimes incomplete. Tarsus and tibia of male palpus dark brown, clothed with black and a few red hairs, the basal joints of the palpus yellow, with white hairs. Integument of the abdomen mainly pale yellow, the dorsum with irregular black mottling, the venter with a white stripe on each side, otherwise more finely mottled in black.

Carapace rather high, heavy, flattened above, the sides abruptly declining, the posterior declivity less steep. Eyes of the first row marginal, slightly recurved, the upper margins forming a straight line, the medians much larger (23/16), subcontiguous, as near the laterals. Small eyes of the second row nearer the eyes of the third row (12/19). Posterior eye row broader than the first (93/87), the eyes equal in size to the anterior laterals. Quadrangle of eyes occupying one-half the total length of the carapace. Clypeus vertical, one-fourth as high as the diameter of an anterior median eye. Chelicera with a single tooth on the lower cheliceral margin. Posterior coxae contiguous. Tibia of the first legs with 1-2-2 ventral spines and one prolateral, the metatarsus with 2-2 ventral spines. Palpus as figured.

**FEMALE.**—Total length, 2.70 mm. Carapace, 1.34 mm. long, 1.08 mm. wide. Color exactly as in the male. Structure essentially as in the male. Epigynum as figured.

**TYPE LOCALITY.**—Male holotype and female allotype from fifteen miles southwest of Harlingen, Texas, taken November 18, 1934, by Mr. Stanley Mulaik.

*Sitticus floridanus*, new species

Figure 21

**MALE.**—Total length, 2.60 mm. Carapace, 1.30 mm. long, 1.00 mm. wide.

Carapace dark brown, the eye region black, the sides and the posterior declivity streaked in black, the margins with a very narrow black seam. Carapace clothed

with white hairs which are more numerous in the eye region; first row of eyes with a few red hairs between them. Sternum, mouth parts and coxae light brown, with some black markings, sparsely clothed with inconspicuous pale hairs. Legs light brown, annulate in dark brown, clothed with a few white hairs. Abdomen light brown, thickly covered with black markings which form distinct chevrons in the caudal half.

Structure essentially as in *Sitticus callidus*, new species. Carapace longer than broad, flat above, the sides abruptly dropping, the posterior declivity more gradually declining. Eyes of the first row subcontiguous, recurved, the medians much larger. Eyes of the second row nearer the posterior than the anterior laterals (12/18). Third row of eyes as broad as the first, the eyes equal in size to the anterior laterals. Quadrangle of anterior laterals and the posterior eyes broader than long (90/55). Eyes occupying about half the total length of the carapace. Sternum longer than broad (46/43), cordate, bluntly pointed behind, the posterior coxae contiguous. Lower cheliceral margin unarmed as usual in the genus. Palpus as figured.

TYPE LOCALITY.—Male holotype from Gainesville, Florida, taken March 28, 1934, by Mr. H. K. Wallace.

*Sitticus welchi*, new species

Figure 31

FEMALE.—Total length, 3.75 mm. Carapace, 1.70 mm. long, 1.25 mm. wide.

Color essentially as in *Sitticus callidus*, new species. Carapace light yellowish brown, the ocular quadrangle black, clothed with a few white hairs, though apparently most of them normally present are rubbed off. Underside of carapace and legs pale yellowish brown, unmarked. Abdomen gray, the dorsum with two longitudinal rows of three black spots, the sides with black markings, the venter pale.

Carapace subquadrangular, longer than broad, heavy, flat above, the sides vertical, the posterior declivity more gradually declining. Eyes of the first row recurved, subcontiguous, the upper margins of the large medians forming a straight line with the upper margins of the laterals. Small eyes of the second row nearer the eyes of the third row than the first (12/20). Third row of eyes as broad as the first. Quadrangle of the anterior laterals and the posterior eyes broader than long (11/7), the eyes subequal. Area of the eyes occupying half the length of the carapace. Sternum longer than broad (58/46), the posterior coxae contiguous. Lower margin of the furrow of the chelicera unarmed. Epigynum as figured.

TYPE LOCALITY.—Female holotype, in very poor condition, from Longtry, Texas, taken August 18, 1935, by Mr. Stanley Mulaik.





## FURTHER DIAGNOSES OF NEW AMERICAN SPIDERS

W. J. GERTSCH

The new species described below are based for the most part on material collected in southern Texas by Mr. Stanley Mulaik. In addition, species are named from specimens received from Mr. Peter Steckler of New York City and Mr. H. K. Wallace of Gainesville, Florida. The types are deposited in the collection of The American Museum of Natural History through the courtesy of these collectors.

### Ctenizidae

#### *Pachylomerus funereus*, new species

Figures 1 and 2

**MALE.**—Total length, 14.00 mm. Carapace, 7.00 mm. long, not including the chelicerae, 6.60 mm. wide at the second coxae.

Carapace uniform black, not shining, finely rugose. Median groove semilunar in outline, deep, a little wider than the eye group, placed seven-tenths of the length back (47/70). Carapace nearly truncate in front as seen from above, moderately rounded on the sides back to the widest point, rather abruptly and evenly constricted to the base of the abdomen. Pars cephalica much higher than the thoracic portion.

Eyes of the first row very strongly procurved, the smaller medians separated by scarcely half their greatest diameter, three-fourths their diameter from the large anterior lateral eye. Posterior row of eyes weakly procurved, the oval medians separated by twice their long diameter, by four times their short diameter, two-thirds their short diameter from the lateral eyes. Median ocular quadrangle slightly broader than long (8/7), narrowed in front (80/73). Ratio of the eyes: ALE: AME:PLE:PME = 53:40:30:27.

Sternum longer than broad (9/8), brown with a pale median streak, armed with black hairs on the margins. Labium black, finely rugose, broader than long (30/22), clothed with a few black hairs and armed with nine cusps at the distal end. Endites black, finely rugose, covered sparsely with black hairs and provided with a few cusps on the inner side. Coxae pale brown. Chelicerae black, with six teeth on the retrolateral margin, two of which are smaller, and with seven teeth on the retrolateral margin, four of which are smaller. Legs black, very slightly rugose, especially the first femora, the third tibia with the usual dorsal excavation characteristic of the genus. Distal joints of the first leg with a row of short robust setae on the retrolateral side of the ventral surface, seven on the patella, twenty-two on the tibia, fifteen on the metatarsus and eleven on the tarsus; and with a row on the prolateral side made up of one-third the number. Second leg spined much as the first one. Tarsal claws three, the paired claws on all the legs with a single denticle near the base.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	5.20	3.20	3.60	2.70	1.40	16.10 mm.
II	5.00	2.80	3.00	2.50	1.30	14.60 mm.
III	4.30	2.50	2.50	3.00	2.20	14.50 mm.
IV	5.30	2.80	3.50	4.50	2.30	18.40 mm.

TYPE LOCALITY.—Male holotype from Edinburg, Texas, collected June 1, 1935, by Mr. Stanley Mulaik.

### Uloboridae

#### *Uloborus arizonicus*, new species

##### Figure 3

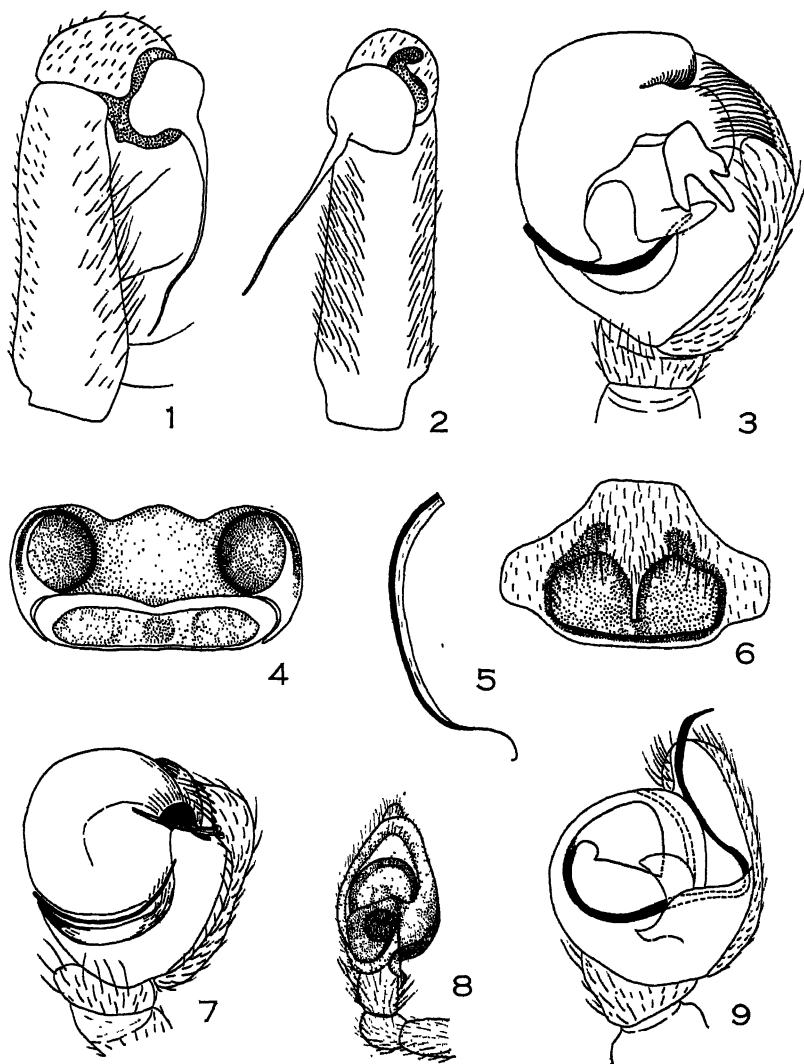
MALE.—Total length, 3.80 mm. Carapace, 1.70 mm. long, 1.50 mm. wide.

Carapace pale yellowish brown, with two inconspicuous narrow black bands that begin near the lateral eye of each side and go caudad to the margin. Eyes narrowly ringed in black. Clothing of the carapace a sparse covering of pale hairs. Sternum, mouth parts, coxae and legs pale yellowish brown to bright orange-brown. Legs clothed with very fine, pale hairs and a few spines. Dorsum of abdomen gray to white, the margins infuscated, medially presenting a longitudinal pale stripe made up of white spots. Venter of abdomen gray with white spots, the whole abdomen clothed with inconspicuous hairs.

Carapace slightly longer than broad, suborbicular in outline, the front margin broadly rounded and without indication of differentiation between the cephalic and thoracic portions. Carapace flattened above for most of the length, the sides declining very abruptly. Pars cephalica indicated from above by rather deep cephalic sutures and a deep median suture, the cephalic sutures forming a very shallow V-shaped figure. Eyes of the first row strongly recurved from in front, apparently procurved as viewed from above, the medians separated by two-thirds their diameter, one and one-half times their diameter from the much smaller lateral eyes, the diameter of which is about half that of the medians. Eyes of the second row weakly recurved, the medians separated by two and one-half times their diameter, about two diameters from the slightly larger lateral eyes. Median ocular quadrangle as broad as long, seemingly much longer than broad, narrowed in front (19/14), the posterior medians much smaller, about equal in size to the anterior laterals. Sternum longer than broad (9/7), weakly rounded in front and on the sides, bluntly pointed between the posterior coxae which are separated by half their width. Labium longer than broad (19/18). First leg considerably longer than the others, without an ornamental fringe as in *Uloborus americanus*, lacking ventral spines but with four prolateral, four retrolateral and eight dorsals on the tibia, most of them concentrated in the distal half of the joint. First leg: femur, 2.10 mm., patella, 0.70 mm., tibia, 1.80 mm., metatarsus, 1.90 mm., and tarsus, 1.00 mm. long. Palpus as figured.

TYPE LOCALITY.—Male holotype from Sabina Basin, Santa Catalina Mountains, Arizona, at 3800 feet elevation, taken July 8–12, 1916, by Dr. F. E. Lutz.

This interesting species is distinguished from all other species from



- Fig. 1. *Pachylomerus funereus*, new species, palp, lateral view.  
 Fig. 2. *Pachylomerus funereus*, new species, palp, ventral view.  
 Fig. 3. *Uloborus arizonicus*, new species, palp, ventral view.  
 Fig. 4. *Agelena oklahoma*, new species, epigynum.  
 Fig. 5. *Agelena oklahoma*, new species, distal end of embolus.  
 Fig. 6. *Agelena absoluta*, new species, epigynum.  
 Fig. 7. *Uloborus segregatus*, new species, palp, ventral view.  
 Fig. 8. *Dictyna meditata*, new species, palp, ventral view.  
 Fig. 9. *Episinus minusculus*, new species, palp, ventral view.

the United States by the very pale coloration, the unbanded and unmarked legs, the nearly straight posterior eye row, and the very broad suborbicular carapace.

*Uloborus segregatus*, new species

Figure 7

MALE.—Total length, 2.66 mm. Carapace, 1.10 mm. long, 0.94 mm. wide.

Carapace sparsely clothed with inconspicuous pale hairs. Sides of the carapace dark brown to black, somewhat streaked, with a median longitudinal pale stripe that begins within the median ocular quadrangle as a narrow streak and expands gradually to the caudal margin where it is slightly wider than the width of the median eyes of the posterior row. Sternum pale yellowish brown, with a median dark streak. Mouth parts and coxae pale yellowish brown, infuscated or sometimes marked with pink or bright red. First leg black to reddish brown, the femur infuscated, the distal joints progressively darker reddish brown. Second leg as the first. Third leg pink to reddish brown, the metatarsus and the tarsus pale yellow. Femur of the fourth leg variegated with pink, the tarsus pale yellow, the intermediate joints mainly pink. Abdomen variable, the dorsum with a narrow median longitudinal black stripe, flushed with pink, the sides and the venter irregularly maculate in black and pink.

Carapace longer than broad, rounded behind and on the sides, the head portion narrowed and somewhat pointed. Median suture a deep excavation, the cephalic sutures obsolete. Carapace rather low but convex, equal in height for most of the length. Eyes of the first row straight from in front, strongly recurved as seen from above, the medians separated by three-fourths their diameter, as far from the much smaller lateral, the diameter of which is about one-half that of the median eye. Eyes of the second row strongly recurved, the medians separated by two diameters, one and one-third their diameter from the subequal laterals. Median ocular quadrangle longer than broad (26/25), apparently much longer than broad, the anterior eyes larger. Sternum longer than broad (60/44). Labium longer than broad (15/14). First leg: femur, 1.50 mm., patella, 0.54 mm., tibia, 1.20 mm., metatarsus, 1.35 mm. and tarsus, 0.54 mm. long.

FEMALE.—Total length, 5.00 mm.

Coloration much more variable than in the male. Carapace dark on the sides, occasionally with a narrow white marginal band, invariably with a light median stripe that expands caudally. Abdomen bituberculate, very much elevated at the middle, the posterior declivity abrupt. Abdomen immaculate white to yellow or marked as in the male (in which case the abdomen is not elevated) or conspicuously spotted in black as follows: one spot at the base of the dorsum and two very large spots on each side. Structure essentially as in the male. Epigynum as in *Uloborus americanus*.

TYPE LOCALITY.—Male holotype and two male paratypes from Edinburg, Texas, taken September 16, 1935, by Mr. Stanley Mulaik. Female allotype and paratypes from 5 miles southeast of Weslaco, Texas, July 21, 1935 (S. Mulaik).

This species differs from *Uloborus americanus* in lacking the ornamentation on the tibia of the first leg, in not having the legs conspicu-

ously banded, in the expanded pale marking on the carapace and in the details of the genital organs.

### Dictynidae

#### *Dictyna meditata*, new species

Figure 8

MALE.—Total length, 1.80 mm. Carapace, 0.76 mm. long, 0.58 mm. wide.

Carapace reddish brown, darker on the sides, the posterior declivity streaked in black, clothed with long white hairs. Eyes narrowly ringed in black. Sternum, mouth parts and chelicerae reddish brown. Legs pale yellow, unmarked, clothed with pale hairs. Abdomen light reddish brown on the sides, the dorsum with a median longitudinal white band, the venter paler.

Carapace longer than broad, widest between the second coxae, the pars thoracica suborbicular in outline as seen from above, convex, the pars cephalica much higher, very strongly convex, the width at the second eye row less than two-thirds the greatest width (35/58). Clypeus one and one-half times as high as the diameter of an anterior median eye. Eyes of the first row straight, the medians separated by a diameter, half as far from the larger laterals. Second row of eyes weakly recurved, the medians separated by a diameter, as far from the subequal laterals. Median ocular quadrangle broader than long (18/13), as wide in front as behind, the posterior eyes slightly larger. Sternum longer than broad (46/40), truncated in front, bluntly rounded behind, the posterior coxae separated by their width. Labium broader than long (16/13). Legs without spines, the first tibia and patella, 0.80 mm. long. Palpus as figured, the tibia with a very short dorsal spur near the base.

TYPE LOCALITY.—Male holotype and paratype from La Buena Ventura, Vera Cruz, Mexico, July, 1909, Dr. A. Petrunkevitch, collector. Male paratype from La Ceiba, Honduras.

### Oonopidae

#### *Opopaea devia*, new species

Figure 13

FEMALE.—Total length, 1.63 mm. Carapace, 0.57 mm. long, 0.46 mm. wide.

Carapace bright reddish brown, darker on the sides, clothed with a few erect black hairs, the eyes enclosing a black field. Sternum, mouth parts and appendages bright reddish brown, lighter than the carapace, sparsely clothed with black hairs. Abdomen pale white to gray, the dorsum almost completely covered by a bright reddish brown, sclerotized scutum which is evenly covered with short black hairs, the position of each hair indicated by a shallow round depression. Venter almost completely covered by a similar scutum. Spinnerets with a sclerotized ring encircling them.

Carapace longer than broad, an elongate oval in outline, somewhat emarginated behind and weakly narrowed in front. Carapace convex, flatter than usual in the genus, almost equal in height throughout the length, the posterior declivity moderate. Eyes six, the anterior medians lacking, the lateral eyes large, separated by one-fifth their diameter. Eyes of the second row straight, the medians contiguous, also con-

tiguous with the smaller laterals. Quadrangle of the anterior laterals and the posterior median eyes broader than long (14/12), broader in front, the anterior eyes larger. Sternum longer than broad (40/32), truncated in front, weakly rounded on the sides, truncated between the posterior coxae which are separated by more than the length of the coxa (16/13). Labium broader than long (11/6), about half as high as the convergent endites. Legs without spines. Coxae abruptly constricted near the base.

**TYPE LOCALITY.**—Female holotype from Edinburg, Texas, taken May 30, 1935, by Mr. Stanley Mulaik.

***Oonops stylifer*, new species**

Figures 10, 11, and 12

**MALE.**—Total length, 1.30 mm. Carapace, 0.63 mm. long, 0.45 mm. wide.

Carapace pale yellow, darker on the sides, the eyes enclosing a black field, clothed with a few erect black hairs. Under parts and legs pale yellow, sparsely covered with black hairs. Abdomen white to gray, clothed with inconspicuous dark hairs.

Carapace longer than broad, a long oval in outline, the caudal margin truncated, the sides rounded, the anterior end narrowed, weakly constricted at the sides just behind the eyes. Carapace convex, equal in height for most of the length, the posterior declivity moderate. Eyes six, the anterior medians lacking, the large laterals separated by one-half their diameter. Eyes of the second row recurved, a line through the centers of the laterals cutting the posterior margin of the medians, the median eyes contiguous, subcontiguous with the equal laterals. All eyes subequal. Quadrangle of the anterior laterals and the posterior median eyes broader than long (14/8), narrowed behind (14/9). Sternum longer than broad (40/36), truncated in front, weakly rounded on the sides, truncated between the posterior coxae which are separated by their length. Labium broader than long (12/7). Coxae constricted near the base. Palpus as figured, the embolus a very long, fine spine.

**TYPE LOCALITY.**—Male holotype from Edinburg, Texas, June, 1935, collected by Mr. Stanley Mulaik.

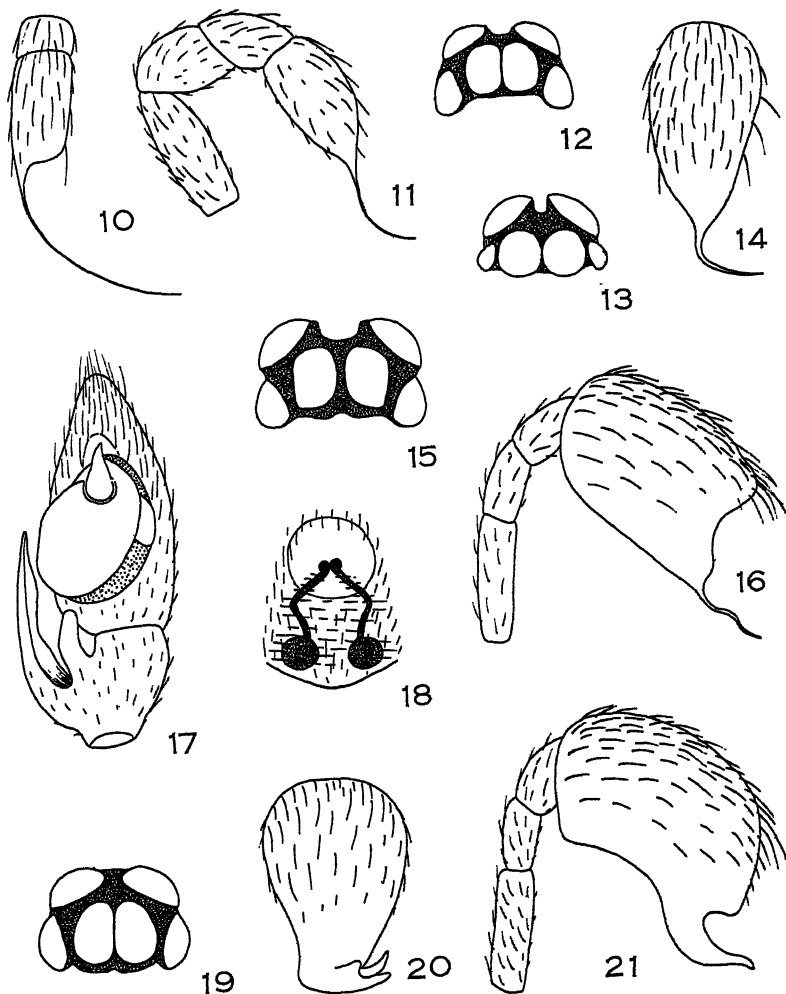
***Oonops furtivus*, new species**

Figures 19, 20, and 21

**MALE.**—Total length, 1.45 mm. Carapace, 0.64 mm. long, 0.48 mm. wide.

Carapace, appendages and abdomen concolorous, gray to pale yellow. Carapace clothed with long dark erect hairs. The posterior legs with a few very weak spines. Abdomen evenly clothed with long dark erect hairs.

Carapace longer than broad, oval in outline, narrowed slightly in front to form the head portion, weakly rounded behind. Pars thoracica convex, a little higher than the head portion, the sutures obsolete. Eyes six, the anterior medians missing, the anterior laterals separated by scarcely a radius. Eyes of the second row recurved, the medians contiguous, subcontiguous with the subequal laterals. All eyes subequal. Quadrangle of the anterior laterals and the posterior medians broader than long (15/10), narrowed behind in the same ratio. Sternum longer than broad (42/36), truncated in front, weakly rounded on the sides, broadly rounded between the



- Fig. 10. *Oonops stylifer*, new species, palpus, dorsal view of tarsus.  
 Fig. 11. *Oonops stylifer*, new species, palpus, lateral view.  
 Fig. 12. *Oonops stylifer*, new species, eyes.  
 Fig. 13. *Opopaea devia*, new species, eyes.  
 Fig. 14. *Oonops secretus*, new species, palpus, dorsal view of tarsus.  
 Fig. 15. *Oonops secretus*, new species, eyes.  
 Fig. 16. *Oonops secretus*, new species, palpus, lateral view.  
 Fig. 17. *Phrurolithus leviculus*, new species, palpus, ventral view.  
 Fig. 18. *Phrurolithus leviculus*, new species, epigynum.  
 Fig. 19. *Oonops furtivus*, new species, eyes.  
 Fig. 20. *Oonops furtivus*, new species, palpus, dorsal view of tarsus.  
 Fig. 21. *Oonops furtivus*, new species, palpus, lateral view.



posterior coxae which are separated by their width. Labium broader than long (11/8). Coxae weakly constricted near the base. First legs unspined, the last with weak spines as follows: tibia, prolateral and retrolateral, 1-1-1, ventral, 1-1-2; metatarsus, prolateral and retrolateral, 1, dorsal, 1, ventral, 2-2-2. Tarsus of male palpus greatly enlarged, the embolus a heavy curved spur. Details of palpus as figured.

**TYPE LOCALITY.**—Male holotype from seven miles east of Edinburg, Texas, February 17, 1935, collected by Mr. Stanley Mulaik. Two male paratypes from Edinburg, Texas, June, 1935 (S. Mulaik).

### *Oonops secretus*, new species

Figures 14, 15, and 16

**MALE.**—Total length, 1.40 mm. Carapace, 0.64 mm. long, 0.46 mm. wide.

Carapace, appendages and abdomen pale yellow in color, the eyes enclosing a black field. Hairs mostly rubbed off but apparently once sparsely covering the whole carapace and abdomen. Legs clothed with inconspicuous dark hairs.

Carapace longer than broad, convex, a long oval as seen from above, weakly rounded behind, narrowed somewhat in front. Height of the carapace about equal throughout the length, the posterior declivity moderate, the sutures obsolete. Eyes six, the anterior medians missing, the anterior laterals large, separated by two-thirds their diameter. Eyes of the posterior row recurved, the medians contiguous, sub-contiguous with the slightly smaller laterals. Quadrangle of the anterior laterals and the posterior medians broader than long (17/10), narrowed behind (17/12), the eyes subequal. Sternum longer than broad (41/35), truncated in front, rounded on the sides, broadly rounded between the posterior coxae which are separated by their width. Labium broader than long (12/7). Last leg with two unpaired weak spines beneath the tibia and one single spine beneath the metatarsus. The rubbed nature of the specimen makes it uncertain that some spines are not missing.

**TYPE LOCALITY.**—Male holotype from fifteen miles southwest of Harlingen, Texas, taken November 18, 1934, by Mr. Stanley Mulaik.

This tiny spider may well be identical with *Oonops spinimanus* Simon of the West Indies, but the apparent lack of a conductor of the embolus and the other slight differences in the palpus make it equally probable that two species are represented.

### *Oonops spinimanus* Simon

*Oonops spinimanus* SIMON, 1891, Proc. Zool. Soc. London, p. 563, Pl. XLII, fig. 6.

**RECORD.**—Females from Newman's Lake, near Gainesville, Florida, taken June 13, 1935, by W. Ivie and W. J. Gertsch, seem to belong to this species. The armature of spines on the palpus of the females agrees well with Simon's species. Other females have been taken at other localities in Alachua County, Florida, by Mr. H. K. Wallace.

**Oonops floridanus** (Chamberlin and Ivie)

*Oonopinus floridanus* CHAMBERLIN AND IVIE, 1935, Bull. Univ. Utah, XXVI, p. 9, Pl. II, figs. 8, 9.

RECORD.—This species, which is somewhat smaller than *Oonops spinimanus* Simon was common at Newman's Lake, near Gainesville, Florida, June 13, 1935 (W. Ivie and W. J. Gertsch). The female lacks the armature of long spines that is found in *spinimanus*. The species, described in *Oonopinus*, is congeneric with *spinimanus* and the species diagnosed above, and is closely related to *Oonops furtivus*, new species.

**Theridiidae*****Episinus minusculus*, new species**

## Figure 9

MALE.—Total length, 1.50 mm. Carapace, 0.60 mm. long, 0.52 mm. wide. Abdomen, 0.93 mm. long, 0.60 mm. wide.

Carapace with a median longitudinal black band that encloses the eye region and runs caudad to the end of the carapace; the sides with a pale yellow band in which are three black spots, the margins with a black seam. Sternum pale yellow, broadly margined in black. Coxae and labium pale yellow to white, the endites marked with black. Basal portion of first and fourth femora yellow, the distal end with broad black annulae. Patellae of these legs black, the tibiae and metatarsi with distal annulae, otherwise pale yellow. Second leg with an incomplete ring on the patella and with narrow distal black annulae on the tibia and metatarsus. Fourth leg with a distal ring on the metatarsus, otherwise pale yellow to white. Basal joints of palpus black, the tarsus light brown. Abdomen irregularly maculate above with black and white, darkest at the anterior end and on the small side tubercles. Venter mainly black.

Eyes of the first row straight from in front, strongly recurved as seen from above, the medians separated by two-thirds their diameter, subcontiguous with the subequal laterals. Second row of eyes slightly procurved, the medians separated by nearly two-thirds their diameter, as far from the subequal laterals. Median ocular quadrangle as broad as long, slightly narrowed behind, the eyes subequal. Clypeus one and one-half times as high as the diameter of an anterior median eye. Sternum longer than broad (41/34), truncated behind, the posterior coxae separated by their length. Palpus as figured.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	0.85	0.27	0.63	0.67	0.34	2.76 mm.
II	0.55	0.20	0.34	0.38	0.25	1.72 mm.
III	0.38	0.17	0.24	0.30	0.28	1.37 mm.
IV	0.75	0.27	0.56	0.65	0.35	2.58 mm.

TYPE LOCALITY.—Male holotype from five miles south of San Juan, Texas, February 22, 1935, collected by Mr. Stanley Mulaik.

## Argiopidae

*Tetragnatha seminola*, new species

. Figures 22 and 23

MALE.—Total length, 5.70 mm., not including the chelicerae. Carapace, 2.00 mm. long, 1.30 mm. wide.

Carapace yellow, the cephalic sutures darkened, the eyes ringed in black. Legs concolorous with the carapace, unmarked, armed with rows of black hairs and a few short weak spines. Abdomen yellow, reticulated in gray.

Carapace much longer than broad, low, the sutures well marked. Eyes of the first row nearly straight as seen from in front, recurved from above, the medians separated by their diameter, one and one-half diameters from the much smaller laterals. Eyes of the second row weakly recurved, the medians separated by nearly one and one-half times their diameter, about as far from the smaller laterals. Median ocular quadrangle as broad as long, equally wide in front as behind, the eyes subequal, the anterior median a diameter from the posterior median eye. Lateral eyes of each side subequal in size, separated by a diameter, nearer together than the median eyes (10/6). Clypeus scarcely as high as the diameter of an anterior median eye. Eyes occupying six-sevenths of the width of the head at that point. Median groove situated back seven-tenths of the total length. Sternum four-fifths as broad as long, truncated below the labium and with a small hook at each side, extended behind as a narrow band between the posterior coxae which are separated by one-third their width. Labium as broad as long, three-sevenths as long as the subparallel endites. Chelicera dorsally with a very stout tooth near the distal end that has a weak tooth below the apex, with two very stout teeth near it on the inner side and six smaller teeth along the inner margins that are spaced in the distal three-fourths of the joint; lower cheliceral margin with six teeth below, spaced in the distal half. Claw evenly curved. Cymbium of male palpus normal, the paracymbium very weakly emarginated at the distal end. Patella and tibia of palpus subequal in length. First leg: femur, 4.30 mm., patella 0.75 mm., tibia, 4.15 mm., metatarsus, 4.15 mm., and tarsus, 1.30 mm. long.

TYPE LOCALITY.—Male holotype and paratype from the northeast shore of Lake Okeechobee, Florida, collected November 16, 1932, by Mr. H. K. Wallace, the paratype in the collection of the collector.

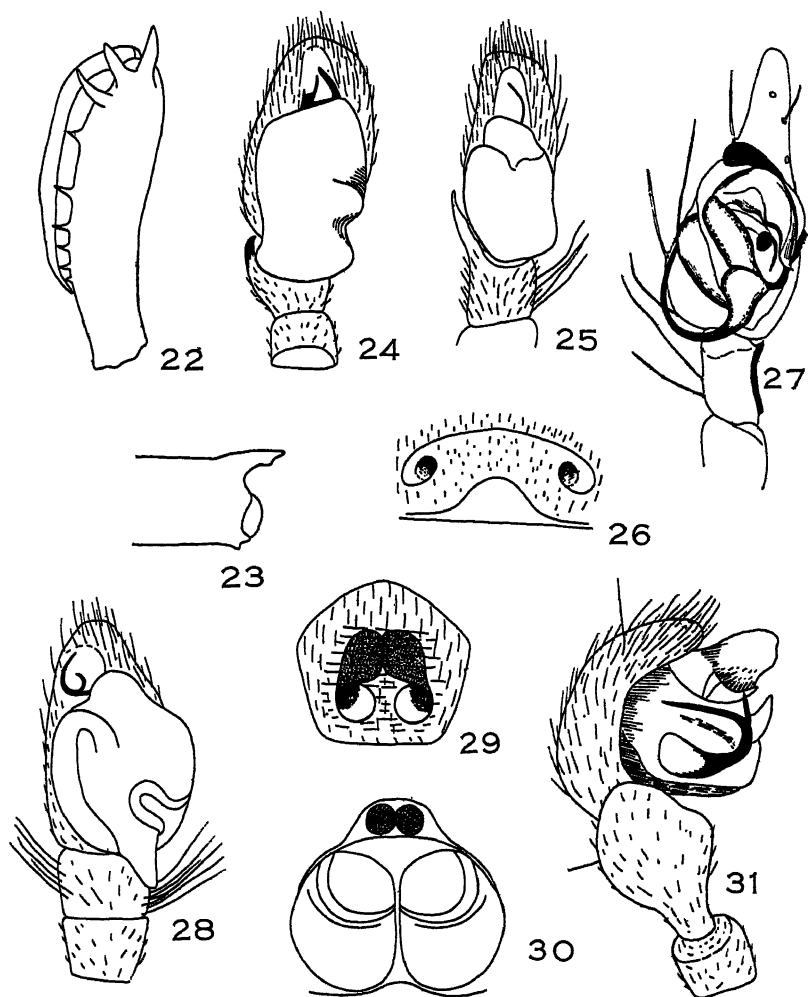
This species is related to *Tetragnatha antillana* Simon but is much smaller, paler in color, has shorter legs and differs in the details of the palpus and chelicera.

*Metepeira minima*, new species

Figure 31

MALE.—Total length, 2.70 mm. Carapace, 1.50 mm. long, 1.18 mm. wide.

Carapace dark brown, the cephalic portion pale yellowish brown, the thoracic portion with dark streaks, the eyes ringed in black. Carapace rubbed but apparently once sparsely covered with long pale hairs, the pars cephalica with two long spines on each side just behind the posterior lateral eyes, the clypeal margin with pale, weak spines. Chelicerae brown. Sternum brown, paler in the middle, the endites brown,



- Fig. 22. *Tetragnatha seminola*, new species, right chelicera, dorsal view.  
 Fig. 23. *Tetragnatha seminola*, new species, right chelicera, lateral view of distal portion.  
 Fig. 24. *Metaphidippus furcifer*, new species, palpus, ventral view.  
 Fig. 25. *Rhetenor texanus*, new species, palpus, ventral view.  
 Fig. 26. *Rhetenor texanus*, new species, epigynum.  
 Fig. 27. *Wadotes tennesseensis*, new species, palpus, ventral view.  
 Fig. 28. *Neonella vinnula*, new species, palpus, ventral view.  
 Fig. 29. *Neonella vinnula*, new species, epigynum.  
 Fig. 30. *Bredana alternata*, new species, epigynum.  
 Fig. 31. *Metepeira minima*, new species, palpus lateral view.

distally paler. Coxae pale yellow. Integument of the legs pale yellow, the femora dark brown in the distal two-thirds, the patellae and tibiae lighter brown, the distal joints pale yellow; third leg pale throughout. Dorsum of abdomen gray to white, with a dark pattern as in the male of *M. labyrinthea* which masks the lighter color. Venter brown, with a quadrangular transverse black marking which encloses a white spot.

Carapace longer than broad, moderately convex, about equal in height for most of the length, the median suture a slight depression, the striae feebly indicated. Pars cephalica rounded in front, convex. Eyes of the first row slightly recurved as seen from in front, strongly recurved as viewed from above, the medians separated by three-fourths their diameter, half as far from the smaller laterals. Eyes of the second row recurved, the medians separated by two-thirds their diameter, one and one-third their diameter from the smaller laterals. Median ocular quadrangle two-thirds as long as broad, broader in front (30/24), the anterior eyes larger. Clypeus equal in height to one-fourth the diameter of an anterior median eye. Sternum longer than broad, subtriangular, with a small elevation at the third coxa of each side, pointed behind, the posterior coxae subcontiguous. Labium broader than long. Chelicera with three teeth on the lower margin. First tibia with 2-2-2 ventral spines, the last pair distal. First femur with 1-1-1-1 dorsal spines, as many stouter prolateral spines, and two ventral rows of 4 and 3 spines, none of the spines on the femur distal in position. Palpus as figured.

TYPE LOCALITY.—Male holotype and paratype from Edinburg, May 27, 1935, collected by Mr. Stanley Mulaik.

This small *Metepeira* is possibly identical with the species described by F. Cambridge from Mexico as *labyrinthea*. The true *labyrinthea* is very near if not identical with *Metepeira spinipes* F. Cambridge.

### Agelenidae

#### *Agelena oklahoma*, new species

Figures 4 and 5

MALE.—Total length, 10.00 mm., exclusive of the spinnerets. Carapace, 5.00 mm. long, 3.50 mm. wide.

Integument of the carapace dirty yellow, the midline with seven long slender spines placed in a single series from the eye quadrangle to the median suture. Carapace with a narrow black seam on the margins and with two broad black bands above, the color due mainly to the presence of black hairs, the intervals between the bands forming a narrow longitudinal median light stripe. Sternum yellow, with two dark bands, the mouth parts and coxae yellow to light brown, rather thickly clothed with black hairs. Legs concolorous with the carapace, clothed with long black hairs and spines, the tibiae and metatarsi with inconspicuous black annulae. Abdomen reddish brown above, with two black stripes, leaving a paler median longitudinal band. Venter pale yellowish brown, the customary broad black band lacking, except for a narrow black margin line on each side.

Eyes of the first row strongly procurved, subequal, separated by a radius. Eyes of the second row strongly procurved, the medians slightly smaller, separated by a diameter, slightly farther from the laterals. Median ocular quadrangle longer than

broad, very slightly narrower in front, the eyes subequal. Clypeus as high as the diameter of an anterior lateral eye. Chelicerae with three teeth on the lower margin, three on the upper. Spines under all the tibiae, 2-2-2, under the metatarsi, 2-2-2. Tibia and patella of the first leg about equal in length to those joints of the fourth leg, longer than the carapace (12/10). Distal joint of the hind spinnerets twice as long as the basal.

Palpus closely related to the several species of the *naevia* group, differing chiefly in the character of the terminal portion of the embolus. Conductor a sclerotized spur about twice as long as broad, pointed at the end. Embolus a light spiraloïd tube, far exceeding the margins of the cymbium, making one and one-half turns, the distal end acuminate, curved, without a pars pendula.

**FEMALE.**—Total length, 10.00 mm., not including the spinnerets. Carapace 4.30 mm. long, 2.50 mm. wide.

Color and structure of the female essentially as in the male. Venter of the abdomen with two narrow black lines. Legs shorter than in the male, the tibia and patella of the first pair equal in length to the carapace. Chelicerae with three teeth on the lower and three on the upper margin. Distal joint of hind spinnerets a little more than twice as long as the basal joint. Epigynum closely related to that of *Agelena potteri* Blackwall, the atrial cavity much broader than long, the atriobursal orifices well separated.

**TYPE LOCALITY.**—Male holotype and female allotype from Stillwater, Oklahoma, 1934 (Canace Smith).

### *Agelena absoluta*, new species

#### Figure 6

**FEMALE.**—Total length, 10.65 mm., exclusive of the spinnerets. Carapace, 5.00 mm. long, 3.06 mm. wide. Abdomen, 6.40 mm. long, 4.45 mm. wide.

Integument of carapace light brown, the midline with twelve slender bristles in a single series and six on the clypeal margin. Carapace clothed with short black hairs, the margins with a narrow black seam, the dorsum with two longitudinal black stripes. Sternum, mouth parts and coxae light brown, clothed with black hairs. Legs light brown, the femora with some black maculations, the other joints lacking annulae. Abdomen dark brown above, with two pale longitudinal stripes made up of spots in the caudal half.

Eye area scarcely half as broad as the width of the head (7/16). Eyes of the first row strongly procurved, subequal, separated by a radius. Eyes of the second row strongly procurved, subequal, the medians separated by two-thirds their diameter, about a diameter from the laterals. Median ocular quadrangle slightly longer than broad, the eyes subequal. Clypeus equal in height to twice the diameter of an anterior lateral eye. Chelicerae with two subequal teeth on the lower margin, three on the upper. Spines under all the tibiae and metatarsi, 2-2-2. Tibia and patella of the fourth leg about as long as the carapace, longer than tibia and patella of the first leg (8/10). Distal joint of the hind spinnerets nearly twice as long as the basal joint (5/9).

Epigynum resembling in many respects that of *Agelena californica* Banks. Atrium a deep cavity, broader than long, with a finger-like projection from the anterior margin. Atriobursal orifices widely separated. In *californica* the atrium is but

weakly depressed and the orifices are much closer together. In addition to differences in the epigynum this species is distinct from *californica* in size, being considerably larger than that species (10.65 mm./8.00 mm.).

**TYPE LOCALITY.**—Female holotype from Los Angeles, California, November–December, 1927, collected by G. Grant.

***Wadotes tennesseensis*, new species**

**Figure 27**

**MALE.**—Total length, 6.80 mm. Carapace, 3.70 mm. long, 2.50 mm. wide.

Carapace yellowish brown in color, the margins with a narrow black seam, the sides with an indistinct long dark stripe between which is a longitudinal pale band. Carapace clothed sparsely with black hairs. Chelicerae dark brown, the labium and endites light brown, the sternum yellowish brown, all clothed with black hairs. Coxae and legs uniform yellowish brown, without annulae, clothed with black hairs.

Carapace longer than broad, strongly convex, highest just behind the eyes, the sides of the pars cephalica strongly convex, the pars thoracica lower and less convex. Eye area scarcely two-thirds as broad as the carapace (18/30), the first row directed forward, straight, the medians separated by scarcely a radius, as far from the much larger laterals. Second row of eyes straight, the medians separated by scarcely a diameter, fully a diameter from the subequal laterals. Median ocular quadrangle longer than broad, slightly narrower in front, the anterior eyes much smaller. Chelicera with two stout teeth on the lower margin. Sternum longer than broad (35/30), truncated in front, the anterior coxae separated by their length, pointed behind, the posterior coxae subcontiguous. Labium longer than broad (13/11). First tibia and metatarsus with 2–2 ventral spines and one prolateral. Tibia and patella of the first leg as long as the carapace. Palpus as figured.

**FEMALE.**—Total length, 1.50 mm. Color and structure as in the male. Epigynum as in *Wadotes calcaratus* but the finger-like apophysis subspatulate.

**TYPE LOCALITY.**—Male holotype, female allotype and paratypes of both sexes from the sides of Mount Leconte, Great Smoky Mountains, Tennessee, July 9, 1933 (W. J. Gertsch). Idem, three female paratypes, September 9, 1928 (W. M. Barrows).

This species is characterized especially by the palpus which lacks a projection of any kind on the tarsus which, however, is furnished with a deep dorsal depression.

***Cybaeus minoratus*, new name**

*Cybaeus minor* BANKS, 1904, Proc. California Acad. Sci., III, p. 341, Pl. XXXVIII, fig. 4, Pl. XL, fig. 44. (Not *Cybaeus minor* Chyzer and Kulczynski, 1897.)

**Thomisidae**

***Tmarus unicus*, new species**

Length of female holotype, 4.00 mm., from the clypeal margin to the end of the caudal tubercle.

Carapace gray to light brown, marmorate, the dorsum paler, with three white streaks that converge at the posterior declivity, the sides light brown. Clypeal margin and eye region with small brown markings. Sternum and mouth parts dusky over a pale base. Legs dull yellow, thickly maculate with small brown spots. Abdomen marmorate above, the spinal tubercles yellow, the sides lined with white, the venter with a median longitudinal dark band which encloses a paler streak.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.57	0.32	0.87	0.36	0.50	2.50 mm.
Width	1.15	0.75	0.50	0.17	0.50	1.00 mm.

Carapace much longer than broad, subquadrangular in outline, the caudal margin subtruncate, the sides weakly rounded, the truncate clypeus two-thirds as wide as the greatest width. Carapace as seen from the side moderately high, about equally high from the posterior eye row to the posterior declivity, which drops rather abruptly. Clypeus on a slightly lower plane than the rest of the carapace but practically horizontal, with the usual seven spines, six of them margin and one, the median, slightly above the margin. Other spines on the carapace as in other species of the genus. Sternum much longer than broad, clothed with fine black hairs. Labium twice as long as broad. Abdomen two and one-half times as long as broad, highest caudally, very rugose, the spines on elevated tubercles, the caudal tubercle of moderate size.

First row of eyes narrower than the second (9/12), straight, the medians separated by more than two diameters (7/18), as far from the laterals. Second row of eyes recurved, the medians separated by nearly three diameters (10/28), farther from the laterals (28/33). Median ocular quadrangle broader than long (20/24), narrowed in front (16/24). Ratio of the eyes: ALE:AME:PLE:PME = 17:7:14:10. Clypeus about as broad as the height of the median quadrangle (19/20).

Leg formula, 1243. First femur one and one-half times the length of the carapace. Legs clothed with fine black hairs, the first and second metatarsi with three pairs of ventral spines, the last pair apical.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	2.25	0.75	1.62	1.40	0.75	6.77 mm.
II	2.10	0.75	1.57	1.35	0.75	6.52 mm.
III	0.75	0.37	0.80	0.42	0.40	2.74 mm.
IV	1.17	0.37	0.80	0.42	0.40	3.16 mm.

TYPE LOCALITY.—Immature female holotype from Edinburg, Texas, taken March 3, 1934, by Mr. Stanley Mulaik.

### *Xysticus furtivus*, new species

Total length of female allotype, 3.75 mm.

Color as in *Xysticus cunctator* but the carapace somewhat more mottled with black, the cephalic portion of the pale longitudinal stripe considerably invaded by dark markings. Legs white, the basal joints with distinct large black maculations. Abdomen mainly gray, inconspicuously spotted with black.



	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.75	0.53	0.87	0.30	0.55	2.12 mm.
Width	1.85	1.00	0.72	0.40	0.25	2.50 mm.

Carapace clothed with conspicuous erect black spines, placed as usual in the genus, the clypeal margin with seven. Pars cephalica at the second eye row about two-thirds as wide as the greatest width (47/75). Abdomen set with long black spines.

Eyes of the first row narrower than the second (28/31), recurved, the medians separated by nearly three diameters (14/38), a diameter from the laterals (14/16). Second row of eyes recurved, the medians separated by two and one-half diameters (13/32), farther from the laterals (13/45). Median ocular quadrangle broader than long (63/55), broader in front (63/58). Ratio of the eyes: ALE:AME:PLE:PME = 22:14:18:13. Clypeus about twice as high as the diameter of an anterior median eye (14/25).

Legs clothed with strong hairs, the spinal armature being as follows: femur, prolateral, 3, otherwise, 0. Tibia, prolateral and retrolateral, 0, ventral, 1-2-2-2. Metatarsus, prolateral, 0-1-1, retrolateral, 0-1-0, ventral, 1-2-2-2. First leg: femur, 1.57 mm., patella, 0.92 mm., tibia, 1.12 mm., metatarsus, 1.12 mm., and tarsus, 0.62 mm. long.

Vulva oval to suborbicular in outline, shallowly excavated, provided with a very narrow median septum that is only slightly expanded near the caudal end. Atriobursal orifices running obliquely forward from near the caudal end of the median septum.

Total length of male holotype, 3.00 mm.

Color as in the female but the carapace darker, reddish brown, the median band virtually obsolete. Basal joints of the legs heavily maculate in black.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.60	0.42	0.80	0.32	0.42	1.60 mm.
Width	1.60	0.87	0.65	0.25	0.18	1.60 mm.

Spinal armature of the carapace and abdomen as in the female.

Eyes of the first row narrower than the second (23/26), recurved, the medians separated by two diameters (13/30), a diameter from the laterals (13/13). Second row of eyes recurved, the medians separated by two diameters (12/27), three diameters from the laterals (12/35). Median ocular quadrangle broader than long (53/46), slightly broader in front (53/51). Ratio of the eyes: ALE:AME:PLE:PME = 23:13:17:12. Clypeus about as high as the diameter of an anterior median eye (13/18).

Spines of the first leg: femur, prolateral, 4, dorsal, 3. Tibia, prolateral and retrolateral, 1-1-1, ventral, 2-2-2-2. Metatarsus, prolateral, 0-1-1, retrolateral, 0-0-1, ventral, 2-2-2. First leg: femur, 1.62 mm., patella, 0.75 mm., tibia, 1.12 mm., metatarsus, 1.25 mm., and tarsus, 0.70 mm. long.

Palpus essentially as in *cunctator* but the embolus completely lacks a pars pendula.

TYPE LOCALITY.—Male holotype and female allotype from Edinburg, Texas, collected by Mr. Stanley Mulaik.

**Clubionidae*****Syspira analytica* Chamberlin**

*Syspira analytica* CHAMBERLIN, 1924, Proc. California Acad. Sci., (4), XII, p. 663, Fig. 107.

LOCALITY.—Tucson, Arizona, July–August, 1935, a female probably of this species collected by Mr. Peter Steckler.

***Syspira eclecticica* Chamberlin**

*Syspira eclecticica* CHAMBERLIN, 1924, Proc. California Acad. Sci., (4) XII, p. 664, Fig. 108.

LOCALITY.—Tucson, Arizona, July–August, 1935, a male probably of this species, characterized by the large size of the anterior median eyes, collected by Mr. Peter Steckler.

***Chemmis steckleri*, new species**

FEMALE.—Total length, 4.60 mm. Carapace, 2.30 mm. long, 1.90 mm. wide.

Carapace uniform yellowish brown, sparsely clothed with short erect black hairs, the eyes ringed in black. Chelicerae reddish brown, armed with long black hairs. Sternum and coxae yellow, with erect black hairs, the labium and endites yellowish brown, distally paler. Legs yellow, unmarked, sparsely clothed with rows of black hairs. Abdomen pale yellow to gray, clothed with fine hairs and evenly covered with black setae.

Carapace longer than broad, evenly convex, moderately high, broad in front, the head portion nearly two-thirds as wide as the widest point (58/95) which is at the third coxae. Head sutures obsolete, the median groove longitudinal. Eyes of the first row weakly procurved as seen from in front, the medians separated by three-fifths their diameter, less than half as far from the smaller laterals. Clypeus equal in height to the diameter of an anterior median eye. Eyes of the second row very weakly procurved, the posterior edges of the eyes in a straight line, the medians separated by one and one-fourth their diameter, as far from the slightly larger lateral eyes. Median ocular quadrangle slightly broader than long (33/30), broader in front by the same ratio, the anterior eyes much larger. Eye group seven-twelfths as wide as the head at that point. Sternum slightly longer than broad (60/55), cordate, broadly truncated in front, the anterior coxae separated by their length, bluntly pointed behind, the posterior coxae subcontiguous. Labium three-fourths as broad as long, subquadrangular in outline, half as high as the subparallel rounded endites. Chelicerae with four well-separated teeth on the lower margin, three on the upper. Coxae subequal in length. First leg spines as follows: femur, dorsal, 1–1, no distals, prolateral, 1, tibia, ventral, 2–2–2–2–2–2, the last pair distal, metatarsus, ventral, 2–2, the last pair not distal. Second leg as first but femur, dorsal, 1–1–1, prolateral, 1–1–1, tibia, ventral, five pairs and two single prolaterals. Tibia and patella I, 2.45 mm., IV, 2.00 mm. long. Terminal joints of spinnerets very short. Epigynum not fully developed.

TYPE LOCALITY.—Female holotype from Tucson, Arizona, July–August, 1935, collected by Mr. Peter Steckler.

This species is distinct from *Chemmis frederici* Simon in lacking a dark pattern on the dorsum, in the presence of distal spines beneath the anterior tibiae and in having four teeth on the lower cheliceral margin. The species described by Banks from Arizona, *Chemmis unicolor*, probably belongs in *Anachemmis* Chamberlin, for the anterior median eyes are not larger than the laterals.

**Phrurolithus leviculus, new species**

Figures 17 and 18

**MALE.**—Total length, 1.30 mm. Carapace, 0.65 mm. long, 0.55 mm. wide.

Integument of the carapace pale yellow to white, smooth, the few hairs inconspicuous, the eyes ringed in black. Under parts and legs concolorous with the carapace, the distal joints of the palpus light brown. Abdomen pale yellow, the dorsum somewhat sclerotized, clothed sparsely with pale hairs.

Carapace longer than broad, convex, the sutures obsolete. Pars cephalica at the second eye row about three-fifths as broad as the carapace. First row of eyes slightly narrower than the second, procurved, the medians separated by one-fourth their diameter, subcontiguous with the subequal laterals. Second row of eyes procurved, the medians very large, oblique, close together, separated by one-fifth their long diameter, as far from the much smaller laterals. Median ocular quadrangle as broad as long, slightly narrowed in front, the posterior eyes very much larger. Clypeus as high as three-fourths of the diameter of an anterior median eye. Sternum longer than broad (44/40), cordate, broadly truncated in front where the anterior coxae are separated by one and one-fourth times their length, gently rounded on the sides, bluntly rounded behind and between the posterior coxae which are separated by nearly their length (15/18). Labium broader than long (13/7). Tibia of the first leg with five pairs of ventral spines, the last pair not distal, the metatarsus with four pairs, no distals. First leg: femur, 0.57 mm., patella, 0.23 mm., tibia, 0.59 mm., metatarsus, 0.57 mm., and tarsus, 0.33 mm. long. Palpus as figured, the ventral femoral spur near the base of the joint.

**FEMALE.**—Total length, 1.55 mm. Color as in the male. Structure essentially as in the male but the eyes of the posterior row straighter, the medians proportionately not so large and slightly farther apart. Epigynum as figured.

**TYPE LOCALITY.**—Male holotype, female allotype and male and female paratypes from Edinburg, Texas, June 2, 1935, collected by Mr. Stanley Mulaik. Female paratype from Edinburg, Texas, September 14, 1935 (S. Mulaik).

**Salticidae**

**Peckhamia seminola, new species**

Figures 36 and 37

**MALE.**—Total length, 3.80 mm. Carapace, 2.00 mm. long, 1.10 mm. wide.

Carapace reddish brown, thinly covered with white hairs, the posterior eyes broadly ringed with black, the anterior laterals with a black maculation behind each

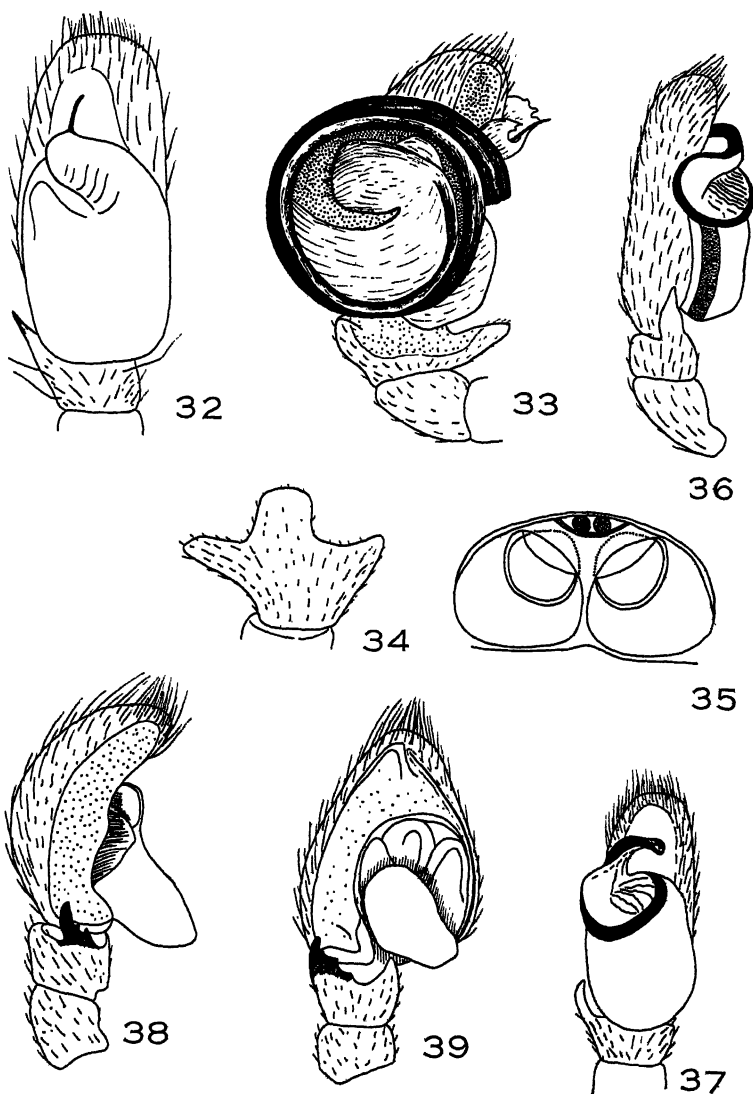


Fig. 32. *Cheliferooides longimanus*, new species, palpus, ventral view.  
 Fig. 33. *Bredana complicata*, new species, palpus, ventral view.  
 Fig. 34. *Bredana complicata*, new species, palpus, dorsal view of tibia.  
 Fig. 35. *Bredana complicata*, new species, epigynum.  
 Fig. 36. *Peckhamia seminola*, new species, palpus, lateral view.  
 Fig. 37. *Peckhamia seminola*, new species, palpus, ventral view.  
 Fig. 38. *Hycitia grata*, new species, palpus, lateral view.  
 Fig. 39. *Hycitia grata*, new species, palpus, ventral view.

one. Legs reddish brown, unmarked, sparsely clothed with inconspicuous hairs. Underside of carapace concolorous with the legs. Abdomen nearly black above, covered with minute iridescent scales and sparsely clothed with white hairs.

Carapace about twice as long as broad, flattened above, the posterior declivity convex, the sides nearly vertical. Eyes of the first row recurved, the upper margins forming a weakly recurved line, subcontiguous, the diameter of the laterals about half that of the large medians. Small eyes of the second row much nearer the anterior laterals than the posterior side eyes (25/51). Posterior row of eyes broader than the first row (11/10), the quadrangle of the laterals longer than broad (106/97). Eyes occupying three-fifths of the total length of the carapace (12/20). Sternum much broader than long (7/3), pointed behind, the posterior coxae contiguous. Anterior coxae separated by about one-fourth their width. Chelicerae slightly excavated on the inner side, the lower margin with a compound tooth, the upper margin with the two teeth near together but separated. Abdomen longer than broad (9/6), normal, unconstricted. First leg considerably enlarged, the prolateral and retrolateral surfaces of the femur, patella, and tibia flattened, the tibia twice as long as its breadth as seen from the side. First leg spined as follows: femur, dorsal, 1-1, tibia, ventral, 2-2-2, the metatarsus, ventral, 2-2, elsewhere none. Tibia and patella of the first leg seven-tenths as long as the carapace. Palpus as in *Peckhamia americana* (Peckham) but the embolus much heavier and more strongly curved. Details of palpus as figured.

TYPE LOCALITY.—Male holotype from Fort Meyers, Florida.

This is the fifth species of *Peckhamia* to be described from the United States. It is closely related to *P. americana* but differs in having the abdomen unconstricted and in the details of the palpus.

#### *Salticus austinensis*, new name

*Epiblemum albocinctus* PECKHAM, 1896, Occas. Papers Nat. Hist. Soc., Wisconsin, III, p. 84.

*Salticus albocinctus* PECKHAM, 1909, Trans. Wisconsin Acad. Sci., XVI, p. 479. (Not *Salticus albocinctus* C. Koch, 1846.)

#### BREDANA, NEW GENUS

A genus of the subfamily Marpissinae. Carapace moderately high, longer than broad, gently rounded on the sides, the posterior declivity steep. Eyes of the first row recurved, subcontiguous, the laterals half the diameter of the medians. Small eyes of the second row nearer the laterals. Ocular quadrangle a little broader behind, broader than long, occupying about half the length of the carapace. Sternum longer than broad, truncate in front, the first coxae widely separated. Labium longer than broad. Chelicera with a single tooth on the lower margin. Legs all weak, none enlarged or modified, unspined, except the first metatarsus.

GENOTYPE.—*Bredana complicata*, new species.

This genus is closely related to *Salticus* but is distinct in the comparatively weak chelicerae of the male, the position of the small eyes of the second row, in having spines beneath the first metatarsi and in the very complicated palpus.

*Bredana complicata*, new species

Figures 33, 34, and 35

MALE.—Total length, 3.08 mm. Carapace, 1.50 mm. long, 1.00 mm. wide.

Carapace sparsely clothed with black hairs, with a small patch of white scales between the median eyes of the first row and with similar patches behind the lateral eyes of the third row. Ocular area enclosed in a black maculation which continues behind triangularly from the posterior side eyes to the inconspicuous median suture. Pars thoracica lighter, dark brown. Sternum black, clothed with pale hairs, the mouth parts brown, with a few black hairs. Coxae pale yellow. Legs pale yellow, the femora brown, the patellae and tibiae with a prolateral brown band, the tarsi pale yellow except the first which is dusky. Legs with black hairs and a few white scales above. Palpus brown, the patella with a few white scales above, the hairs of the joints otherwise black. Abdomen black, shining, clothed with black hairs and with five patches of white scales in the basal half, one at the base above the pedicel and two pairs behind near the margin. Sides of the abdomen black, the venter somewhat paler, with white hairs near the base.

Carapace one and one-half times as long as broad, broadest between the second coxae, narrowed slightly in front and narrowed and rounded behind. Carapace highest at the third eye row, declining gradually in front and dropping gradually behind to the posterior declivity which is precipitous, the sides near vertical. Eyes of the first row recurved, the upper margins forming a very weakly procurved line, subcontiguous, the lateral eyes about half the diameter of the large medians. Small eyes of the second row nearer the anterior lateral than the posterior side eye (15/22). Third eye row four-fifths as wide as the carapace at that point, wider than the first row (72/82), the quadrangle of the laterals broader than long (82/58). Eyes occupying about half of the length of the carapace (70/145). Chelicerae moderate in size, set somewhat obliquely, the lower margin with a single tooth. Sternum longer than broad (67/42), broadly truncate in front and separating the anterior coxae by more than their length (7/5), the sides gently rounded, the caudal end bluntly pointed, the posterior coxae subcontiguous, separated by only one-fourth their width. Labium longer than broad (25/20), about half as high as the parallel endites, the distal ends of which are rounded. Legs unspined except the first metatarsus which has a single submedian and a distal pair of ventral spines. Palpus as figured.

FEMALE.—Total length, 3.70 mm. Carapace, 1.50 mm. long, 0.96 mm. wide.

Color and structure as in the male but the abdomen duller black above and pale yellow below.

TYPE LOCALITY.—Male holotype and paratype from below Weslaco, Llano Grande, Texas, April 27, 1934, collected by Mr. Stanley Mulaik. Female allotype from Brownsville, Texas, June 8, 1934, collected by Mr. J. N. Knull.

*Bredana alternata*, new species

Figure 30

FEMALE.—Total length, 3.40 mm. Carapace, 1.72 mm. long, 1.13 mm. wide.

Carapace dull to deep black, the pars thoracica dull black with inconspicuous black lines, clothed evenly but sparsely with white hairs. Sternum black, with black

hairs, the mouth parts dull black, distally paler. Chelicerae black. Legs pale yellow, with very inconspicuous annulae on the basal joints, clothed with white hairs and a few black spines. Abdomen gray above, with indistinct dark chevrons made up of large spots, evenly covered with white and black hairs. Venter pale, dusky yellow.

Carapace one and one-half times as long as broad, narrowed somewhat in front, gently rounded on the sides, widest midway between the posterior eye row and the caudal margin. Carapace as seen from the side flat in the ocular region, the pars thoracica lower, the posterior declivity moderately steep. Sides of the pars cephalica vertical. Carapace evenly covered with round pits from which the white hairs arise. First row of eyes recurved as seen from above, the lateral eyes set farther back, weakly recurved from in front, the upper margins of the eyes forming a weakly procurved line. Eyes of the first row subcontiguous, the diameter of the laterals scarcely half that of the large medians. Small eyes of the second row nearer the anterior laterals than the posterior side eyes (18/30). Third eye row broader than the first (93/100), the eyes equal in size to the anterior laterals, the quadrangle of these eyes broader than long (100/70). Eyes occupying one-half the total length of the carapace. Sternum longer than broad (73/45), truncated in front, the anterior coxae separated by their length or by the width of the labium, pointed behind where the posterior coxae are subcontiguous. Labium slightly broader than long. Chelicera with a single tooth on the lower margin. Legs unspined except for 1-1-1 dorsals on all the femora, 2-2 beneath the first metatarsus and a distal pair beneath the other metatarsi. Epigynum as figured.

TYPE LOCALITY.—Female holotype from fifteen miles southwest of Harlingen, Texas, taken November 18, 1934, by Mr. Stanley Mulaik.

This species may not belong in *Bredana* but as the agreement is good in many characters and the epigyna are similar, it is placed here for the present.

### *Cheliferooides longimanus*, new species

#### Figure 32

MALE.—Total length, 3.20 mm. Carapace, 1.30 mm. long, 0.67 mm. wide.

Carapace light to dark brown, the margins with a black seam, the eye region darker, with two black spots in the center and two dark bands that include the side eyes of each side and are continued caudally to the margin in two less distinct, brown bands, the interval between them yellowish brown. Carapace clothed with black hairs and white scales. Sternum yellow, the coxae somewhat paler, the chelicerae, labium and endites brown. First leg dark reddish brown, the second pale yellow, the last two pale yellow but with a brown prolateral stripe on all the joints but the tarsus. Basal joints of the palpus brown, the tibia and tarsus pale yellow. Dorsum of the abdomen pale yellow to gray, with a central longitudinal dark marking which is followed by three or four chevrons. Sides of the abdomen with a dark band which continues caudally to include the spinnerets, leaving a long oval, pale yellow maculation on the venter.

Carapace longer than broad, subtruncate in front, the sides weakly rounded for two-thirds the length, then gradually narrowed to the pedicel. Carapace flat above,

equal in height for most of the length on the midline, the sides nearly vertical in front but gradually more convex back to the pedicel. Eyes occupying less than half of the length of the carapace (11/27). First row of eyes as broad as the carapace in front, recurved, the dorsal margins forming a very weakly recurved line, subcontiguous, the laterals about half the diameter of the very large medians. Small eyes of the second row much nearer the posterior side eyes than the anterior laterals (11/17). Third eye row as broad as the first, the eyes equal in size to the anterior laterals, the quadrangle of the laterals broader than long (67/48). Sternum twice as long as broad (67/33), narrowed and truncated in front where the anterior coxae are separated by three-fourths their width, rounded on the sides, pointed behind, the posterior coxae subcontiguous. Labium longer than broad (18/15), half as high as the endites which are rounded at the ends. Basal joints of the first leg strongly incrassated, flattened on the sides, the femur from the side three-eighths as broad as long, the tibia from the side twice as long as broad. First tibia with 2-2-2 stout ventral spines in the distal half, the ventral surface also supplied with numerous large spatulate hairs. First metatarsus with 2-2 ventral spines in the distal half. Second leg with 1-1-1 ventral spines beneath the tibia and 1-2 beneath the metatarsus. Last two legs unspined. Tibia and patella of the first leg slightly longer than the carapace, much longer in the male paratype. Palpus as figured.

FEMALE.—Total length, 3.10 mm. Carapace, 1.45 mm. long, 0.75 mm. wide.

Color and structure of the female exactly as in the male but the first leg shorter, the tibia and patella shorter than the carapace (6/7).

TYPE LOCALITY.—Male holotype from below Weslaco, Llano Grande, Texas, taken April 28, 1934, by Mr. Stanley Mulaik. Male paratype from seven miles east of Edinburg, Texas, October 27, 1934 (S. Mulaik). Female allotype from fifteen miles southwest of Harlingen, Texas, November 18, 1934 (S. Mulaik). Female paratype from five miles southwest of Weslaco, Texas, July 21, 1935 (S. Mulaik). Female paratype from Umatilla, Florida, March 2, 1933 (H. K. Wallace).

This interesting species which seems to belong in *Cheliferoides* is quite distinct from *C. segmentatus* F. Cambridge in a number of characters. The broader than long eye quadrangle, which is not wider behind, the much longer and narrower carapace, the presence of large spatulate hairs beneath the greatly incrassated tibia of the first leg and the palpus will separate it from Cambridge's species. A female of a second species from Texas agrees in color pattern with *segmentatus*, which was described from a male, and is probably referable to that species.

#### NEONELLA, NEW GENUS

A genus belonging apparently in the Sitticinae and agreeing with *Neon* in having the lower margin of the chelicera unidentate. Spiders very small, both sexes similar in appearance and structure. Carapace longer than broad, relatively high, flat above. Eyes of the first row straight, contiguous. Small eyes of the second row



approximately midway between the lateral eyes of the first and third rows, the quadrangle of these laterals much broader than long. Eyes occupying one-half the length of the carapace. Sternum longer than broad, broadly truncated in front. Labium longer than broad, the endites convergent and touching at the ends. Legs short, all about equal in size, the first tibia with 2-2 ventral spines, no distals, the metatarsus with 2-2 ventral spines, one pair distal.

GENOTYPE.—*Neonella vinnula*, new species.

### *Neonella vinnula*, new species

Figures 28 and 29

FEMALE.—Total length, 1.50 mm. Carapace, 0.70 mm. long, 0.55 mm. wide.

Carapace bright yellow, the ocular area black except in the middle, the sides with a narrow black marginal seam, the posterior declivity with a few black lines, the integument smooth, with a few black hairs in the ocular region. Sternum, mouth parts and legs bright yellow, clothed with dark hairs, the legs with very faint narrow distal annulae on some of the joints. Palpus black except the coxal portion which is yellow. Abdomen clothed sparsely with pale hairs, the dorsum with two longitudinal black bands the whole length and a like band on each side, leaving a central pale stripe and one on each side. Venter gray to white, with white hairs.

Carapace longer than broad, gently rounded in front, the sides subparallel and vertical, the posterior declivity steeply declining. Sutures obsolete. Pars cephalica flat above, the eyes protruding somewhat beyond the clypeal margin. Eyes of the first row straight, contiguous, the lateral eyes three-fifths the diameter of the large medians. Small eyes of the second row slightly nearer the posterior than the anterior side eyes (6/8). Eyes of the third row slightly broader than the first (55/53), the side eyes larger, the quadrangle of the laterals much broader than long (55/33). Eyes occupying one-half of the total length of the carapace. Sternum broader than long (30/24), broadly truncated in front, the anterior coxae separated by one and one-half times their length, separated by nearly twice the width of the labium, bluntly pointed behind where the posterior coxae are subcontiguous. Labium broader than long, half as high as the rounded, convergent endites. Chelicera with a single small tooth on the lower margin. First leg with 2-2 spines beneath the tibia, a subbasal and a submedian pair, and 2-2 spines beneath the metatarsus, a basal and a distal pair. First leg: femur, 0.33 mm., patella, 0.20 mm., tibia, 0.20 mm., metatarsus, 0.17 mm., and tarsus, 0.16 mm. long. Fourth leg longer than the third. Epigynum as figured.

MALE.—Total length, 1.33 mm. Color essentially as in the female but the abdomen bright yellow, with two dorsal dark bands as in the female but the laterals dark bands reduced in size or missing. Palpus of the male yellow except for a dark spot on the prolateral surface of the femur. Details of palpus as figured.

TYPE LOCALITY.—Male holotype and female allotype from St. Petersburg, Florida, April 8, 1933, collected by Mr. H. K. Wallace. Male paratype from Edinburg, Texas, December, 1934 (S. Mulaik). Female paratype from Cameron County, Texas, December, 1934 (L. Irby Davis).

*Hycia grata*, new species

Figures 38 and 39

MALE.—Total length, 4.40 mm. Carapace, 2.00 mm. long, 1.33 mm. wide.

Carapace dark brown to black, shining, the eye region and sides darker, clothed with a few short white hairs and longer black ones in the ocular region. Sternum and mouth parts dark brown, clothed with dark hairs. Legs yellowish brown, unmarked, sparsely covered with short black hairs. Abdomen pale beneath and with a median dark line, the dorsum dark brown, rather thickly covered with shining golden scales and clothed with a few long dark hairs.

Carapace much longer than broad, moderately high, flat above for most of the length, the sides and the posterior declivity rounded. Carapace broadest at a point between the second and third coxae, somewhat narrowed in front, more broadly rounded caudally. Eyes of the first row very weakly recurved, the upper margins forming a very weakly procurved line, the eyes subcontiguous, the laterals about one-half the diameter of the large medians. Small eyes of the second row midway between the posterior side eye and the anterior laterals, these eyes forming a quadrangle much broader than long (110/75). Third row of eyes broader than the first (60/57), the laterals subequal. Eye group occupying less than one-half of the total length of the carapace (43/100). Sternum five-eighths as broad as long, greatly narrowed in front where the coxae are scarcely separated, bluntly pointed behind, the posterior coxae subcontiguous. Labium longer than broad (30/26). First leg much more robust than the others, the tibia with 2-2-2 ventral spines and a prolateral and retro-lateral that are nearly ventral in position, the metatarsus with 2-2 ventral pairs of spines. First leg: femur, 1.20 mm., patella, 0.80 mm., tibia, 1.00 mm., metatarsus, 0.70 mm., and tarsus, 0.45 mm. long. Palpus as figured.

TYPE LOCALITY.—Male holotype from Minneapolis, Minnesota, May 18, 1932 (W. J. Gertsch).

*Hycia grata* is readily distinguished from the two common species of the genus in the United States. It is much more robust than *H. pikei* and the abdomen is only twice as long as broad. It may be separated from *H. bina* by its much smaller size and its shorter first legs, the tibia and patella of which are longer than the carapace in *bina*, and by the different color pattern. It is structurally much like *H. robusta* of Arizona and California but is a much smaller species.

*Rhetenor texanus*, new species

Figures 25 and 26

MALE.—Total length, 3.30 mm. Carapace, 1.90 mm. long, 1.60 mm. wide.

Carapace dark reddish brown, the eyes broadly ringed with black, clothed sparsely with white scales, the first eye row with longer dark hairs overlapping the eyes. Sides of the carapace with a narrow marginal band of white scales. Sternum light brown, with inconspicuous black hairs, the labium and endites dark reddish brown, the ends paler, clothed with black hairs. First coxa dark brown, the others light brown. First leg dark reddish brown, sparsely clothed with white scales and black hairs. Other legs lighter brown, paler beneath, with brown prolateral and

retrolateral bands, clothed with white scales and black hairs. Abdomen dark reddish brown, shining, strongly sclerotized, with an incomplete median pale transverse band and a curved yellow transverse band just above the spinnerets, the venter lighter brown. Light markings of the dorsum thickly set with white scales.

Carapace weakly convex above, broader than long, the sides vertical, the posterior margin deeply emarginated, the posterior declivity nearly vertical. Eyes of the first row recurved, the medians subcontiguous, the laterals slightly separated from the medians and half their diameter. Small eyes of the second row much nearer the anterior lateral than the posterior side eye (25/75). Posterior eye row much broader than the anterior row (97/70), the side eyes about equal in size to the anterior laterals, the quadrangle of these eyes much broader than long (67/97). Sternum longer than broad (70/62), truncate in front and broadly separating the anterior coxae by their width, bluntly rounded behind, the posterior coxae subcontiguous. Labium broader than long (40/34), half as high as the rounded endites. Chelicerae large, oblique, the upper margin with a small tooth, the lower margin with a large compound tooth as in *Zygoballus*. First leg much heavier than the others, the femora quite flat on the sides, about half as broad as long (40/75), with 1-1-1 dorsals and a single distal prolateral spine. Patella and tibia of the first leg subequal in length, the latter with 2-2-2 stout ventral spines in the distal half, the metatarsus with 2-2 spines beneath. Last two pairs of legs unspined. Palpus as figured. Abdomen longer than broad (85/100), oval, fitting closely in the recurved caudal margin of the carapace.

FEMALE.—Total length, 2.50 mm. Carapace, 1.10 mm. long, 1.50 mm. wide. Structure and color essentially as in the male. Epigynum as figured.

TYPE LOCALITY.—Male holotype from Brownsville, Texas, May 25, 1934, collected by Mr. J. N. Knull. Female allotype from fifteen miles southwest of Harlingen, Texas, November 18, 1934 (S. Mulaik).

This interesting species seems to conform rather well to the genus *Rhetenor* Simon but various differences make it probable that it will ultimately be placed in a distinct genus.

### ***Metaphidippus furcifera*, new species**

#### **Figure 24**

MALE.—Total length, 4.50 mm. Carapace, 2.30 mm. long, 1.77 mm. wide.

Carapace bright reddish brown, the sides darkened, the eyes broadly ringed with black. Sides of the carapace with a narrow marginal line of white scales, with scattered golden scales above the margin and a line of white scales from the posterior side eye to near the caudal margin. Ocular area with inconspicuous golden scales which are more numerous on the sides of the head and between the eyes, the clypeal margin thickly covered with long white hairs. Chelicerae dark reddish brown, the basal half with white hairs, the remainder with black hairs. Sternum dark reddish brown, clothed with soft white hairs, the mouth parts concolorous. Legs dark reddish brown, darker on the prolateral side, the dorsum with a pale stripe. Abdomen dark reddish brown, the dorsum with a narrow white band clothed with white hairs, and two indistinct narrow longitudinal bands the whole length made up of small spots, clothed with white hairs, the remainder of the dorsum with a sparse covering of

iridescent golden scales. Venter brown, with numerous small black spots and clothed with short white hairs.

Carapace longer than broad, widest at the second coxae, the front subtruncate, the posterior margin broadly rounded. Carapace highest at the posterior eye row, gently sloping anteriorly and caudally beyond the median suture, then more strongly declining to the posterior margin. Sides of the pars cephalica weakly convex, subvertical. First row of eyes recurved, a line on the upper edges of the eyes recurved, subcontiguous, the laterals scarcely half the diameter of the large medians. Small eyes of the second row nearer the anterior lateral eye than the posterior side eye (25/35), the quadrangle of these eyes broader than long (9/14), narrower in front (125/137). Eye area occupying five-elevenths of the total length of the carapace. Chelicera with a single tooth on the lower margin. Sternum longer than broad (90/55), truncated in front, the anterior coxae separated by their width, bluntly pointed behind, the posterior coxae subcontiguous. First tibia with 2-2-2 ventral spines in the distal half of the joint, the metatarsus with 2-2 ventral spines. Palpus as figured.

**TYPE LOCALITY.**—Male holotype from below Esparo Ranch, Beaver Creek, Greenlee County, Arizona, collected by Mrs. Frances Frick Jacot.



# AMERICAN MUSEUM NOVITATES

Number 853

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

May 25, 1936

## FURTHER RECORDS AND DESCRIPTIONS OF NORTH AMERICAN GNAPHOSIDAE

BY RALPH V. CHAMBERLIN

The present paper is a report upon additional material of the family Gnaphosidae sent to me for study by The American Museum of Natural History. Descriptions of several forms not represented in this collection are also included. Unless otherwise noted, the types are deposited in the collection of the American Museum.

### HERPYLLUS HENTZ

#### *Herpyllus cratus* Chamberlin

*Herpyllus cratus* CHAMBERLIN, 1922, Proc. Biol. Soc. Washington, XXXV, p. 150.

RECORD.—Texas: Edinburg. One female taken in April, 1934, by Mr. Stanley Mulaik. Previously known from Punta Gorda, Florida.

#### *Herpyllus emertoni* Bryant

Figure 8

*Herpyllus emertoni* BRYANT, 1935, Psyche, XLII, p. 73, Pl. v, figs. 1, 2.

RECORD.—Florida: Alachua County, one male.

#### *Herpyllus bryophilus*, new species

Figure 9

FEMALE.—Carapace, sternum and chelicerae chestnut, the legs a little higher. Abdomen with integument gray.

Tarsi and metatarsi I and II scopulate throughout length, the distal end of tibia I also with scopular hairs. Tarsi III and IV, but not the corresponding metatarsi, also scopulate. Tibia I with ventral spines 1-1-1, and no anterior spine. Tibia II with ventral spines 0-1-1, a single spine on anterior face. Metatarsi I and II with the usual pair of ventral spines. Tibia III with a median dorsal spine, this lacking on tibia IV.

Anterior median eyes somewhat larger than the laterals, their radius apart and much closer to the laterals. Eyes of posterior row nearly equal in size; median eyes their radius apart and but little farther from the laterals. Area of median eyes a little wider in front than behind (cir. 13:12), and longer than wide in front (cir. 12:8).

Four spinning tubules of anterior spinnerets four. Epigynum as figured.

Length, 6.00 mm. Length of cephalothorax, 2.66 mm.; width, 2.00 mm. Length of tibia + patella I, 2.37 mm.; of tibia + patella IV, 2.90 mm.

LOCALITY.—Louisiana: Tallulah. One female (holotype) taken in Spanish moss (R. V. Chamberlin), and now in the University of Utah collection.

*Herpyllus itamus*, new species

Figure 10

FEMALE.—Carapace chestnut, the sternum a little lighter. Legs brown. Integument of abdomen gray.

Tarsi and metatarsi I and II scopulate, the posterior tarsi alone scopulate. Ventral spines of tibia I and II alike, 0-1-1, the former unarmed in front, the latter with a single anterior spine toward distal end. Tibia III with the usual median dorsal spine.

Anterior median eyes less than their radius apart, much closer to the laterals. Posterior median eyes somewhat angulate, appearing a little smaller than the laterals, their diameter, or nearly so, apart and nearly the same distance from the laterals. Area of median eyes wider in front than behind, and a little longer than wide. Epigynum as figured.

Tibia + patella I, 2.29 mm.; IV, 2.50 mm. Length of male, 6.00 mm. Length of cephalothorax, 2.83 mm.; width, 1.87 mm. Length of tibia + patella I, 2.00 mm.; IV, 2.50 mm.

LOCALITY.—Florida: Hastings, female holotype, collected March 3, 1927.

*Herpyllus cepeus*, new species

Figure 13

FEMALE.—Carapace and sternum dilute chestnut, the legs more yellowish brown. Abdomen above dark gray with a lighter mark at base suggesting that of *H. vasifer* followed by several vague light chevron marks; venter lighter gray.

Tarsi and metatarsi I and II scopulate, the tarsi alone of legs III and IV scopulate. Ventral spines of tibiae I and II, 0-1-2, neither with spine on anterior or posterior face. Metatarsi I and II with the usual pair of robust spines at base.

Anterior median eyes obviously larger than the laterals, a little more than their radius apart, much closer to the laterals. Posterior row of eyes longer than the anterior; eyes equidistant, the medians slightly smaller than the laterals. Anterior median eyes larger than the laterals, about their radius apart, closer to the laterals. Area of median eyes longer than wide, wider in front than behind (13:11). Epigynum as figured.

Length, 8.00 mm. Length of cephalothorax, 3.60 mm.; width, 2.50 mm. Length of tibia + patella I, 3.20 mm.; of tibia + patella IV, 3.60 mm.

LOCALITY.—Colorado: Gardner. One female (holotype).

*Herpyllus regnans*, new species

Figure 14

FEMALE.—Carapace, chelicerae and sternum reddish yellow or pale chestnut, the legs clearer yellow. Abdomen dark gray or brownish gray above; lighter, grayish yellow beneath.

Tarsi and metatarsi I and II and tarsi III and IV scopulate as usual. Ventral spines of tibia I, 1-1-2; of tibia II, 0-1-2 or 0-2-2. Tarsi I and II with a pair of stout spines at base as usual.

Posterior row of eyes distinctly longer than the anterior; median eyes scarcely smaller than the laterals, less than their diameter from each other and much more than their diameter from the laterals. Anterior median eyes decidedly larger than the laterals; about three-fourths their diameter from each other, but very close to the laterals. Area of median eyes clearly longer than wide and wider in front than behind. Epigynum as figured.

Length, 10.00 mm. Length of cephalothorax, 5.00 mm.; width, 3.10 mm. Tibia + patella I, 4.00 mm.; tibia + patella IV, 4.50 mm.

LOCALITIES.—Texas: Zapata Co., Arroyo Solado (female holotype), S. Mulaik; Llano Co., Llano (female paratype).

### *Herpyllus reservatus*, new species

Figure 15

FEMALE.—Carapace, chelicerae and sternum brown, the head region and chelicerae darkest. Legs brown. Abdomen dark gray above, paler in a mid-dorsal stripe, especially anteriorly; the venter light gray.

Tibia I with ventral spines 1-1-1, anterior spine near base. Tibia II with ventral spines as in I, and an anterior spine toward distal end. Tibia III with a mid-dorsal spine at base.

Posterior row of eyes gently procurved, eyes subequal and nearly equidistant, the medians being but slightly nearer each other than to the laterals. Anterior median eyes larger than the laterals (diameters not quite 4:3), their radius or scarcely more apart. Area of median eyes as long as wide in front, and wider in front than behind (cir. 8:7). Epigynum as shown in the figure.

Length, 12.00 mm. Length of cephalothorax, 4.79 mm.; width, 3.13 mm. Tibia + patella I, 4.35; IV, 4.35 mm.

LOCALITY.—Arizona: Tucson. One female taken in August, 1935, by Mr. Peter Steckler.

### *LIODRASSUS* CHAMBERLIN

#### *Liodrassus floridicolens*, new species

Figure 16

FEMALE.—Integument of carapace, chelicerae, sternum and legs yellowish. Abdomen above and laterally, dark gray; light gray beneath.

Tarsi and metatarsi I and II scopulate, tarsi III and IV more sparsely scopulate. Tibiae I and II with ventral spines 0-1-1, the spines of corresponding metatarsi 2-0-0. Tibiae III and IV with no median dorsal spines.

Posterior row of eyes straight; eyes about equal; median eyes separated by a diameter or somewhat more, closer to the laterals. Anterior row of eyes equal in length to the posterior row or nearly so; median eyes approximately equal in size to the laterals, about their radius from each other and subcontiguous with the laterals. Area of median eyes slightly longer than wide and wider in front than behind.



Length, 6.00 mm. Length of cephalothorax, 3.00 mm.; width, 2.13 mm. Tibia + patella I, 2.34 mm.; tibia + patella IV, 2.60 mm.

LOCALITY.—Florida: Alachua County, April 15, 1934, female holotype, collected by Mr. H. K. Wallace.

SENGIOLUS SIMON

*Sengiulus amphilogus*, new species

Figure 18

FEMALE.—Carapace irregularly dusky over a yellowish-brown background, the sternum a little lighter. Chelicerae chestnut. Legs with femora dusky over yellow, the other joints yellow excepting the tibia and metatarsus of legs IV which are black throughout excepting distal end of tibia. Abdomen brownish black above crossed transversely with a narrow white stripe near anterior end and a broad white stripe over middle, the latter stripe widening down the sides and across venter where it extends from genital furrow nearly halfway to the spinnerets; venter back of white area blackish. Spinnerets broadly encircled with black, being pale only at the two ends.

The carapace marked with a conspicuous dorsal stria; caudal end mesally incurved.

Anterior tarsi and metatarsi and the posterior tarsi scopulate as usual. Tibia I without spines. Tibia II with ventral spines 0-1-1 or 1-1-1, in the latter case, the proximal spine not far from the median. Metatarsus I unarmed. Metatarsus II with a ventral spine at base. Tibia III with a median dorsal spine.

Posterior row of eyes considerably recurved; eyes nearly equal in size, the medians slightly elongate in the oblique direction, their diameter apart and a little closer to the laterals. Epigynum as figured.

Length, 6.52 mm. Length of cephalothorax, 2.39 mm.; width, 1.52 mm. Tibia + patella I, 1.48 mm.; IV, 1.97 mm.

LOCALITY.—Texas: Brownsville. One female (holotype) taken June 1, 1934, by J. N. Knull.

*Sengiulus bellior*, new species

Figure 17

FEMALE.—Carapace and sternum brownish yellow. The chelicerae chestnut. Legs clear yellow except the femora of legs I and II, which are black, and legs IV, in which the tarsus and metatarsus are black and the tibia nearly so. Palpi black or nearly so. Abdomen black with a transverse white stripe across dorsum at middle, this stripe preceded by a pair of white spots; also a transverse cross stripe across anterior end, this stripe interrupted at middle and continuous down side, on which partially interrupted, and across venter just behind the genital furrow, the white color produced a short distance caudad in a mid-ventral stripe.

Carapace with dorsal stria absent or obscure; caudal margin convexly rounded.

Anterior tarsi and metatarsi scopulate as usual, the posterior tarsi also scopulate but the corresponding metatarsi simple setose. Tibiae I and II with ventral spines

0-0-1. Metatarsus I with no ventral spines and metatarsus II with a single ventral spine at base. Tibia III with a median dorsal spine at base.

Posterior row of eyes recurved; eyes subequal, the medians scarcely the smaller, not quite once and a half their diameter apart and more than once and a half their diameter from the laterals. Anterior row of eyes decidedly shorter than the posterior; eyes nearly equal in size, the medians less than their radius apart and closer to the laterals. Epigynum as shown in the figure.

Length, 6.13 mm. Length of cephalothorax, 2.70 mm.; width, 1.61 mm. Tibia + patella I, 1.74 mm.; IV, 2.10 mm.

LOCALITY.—Texas: Edinburg. One female (holotype) taken September 3, 1934, by S. Mulaik.

### *Sergiolus segregatus*, new species

Figures 11 and 12

Carapace and chelicerae light chestnut. Sternum and coxae of legs beneath yellow. Legs yellow, but with femora of anterior pairs dusky excepting ventrally, the femur of leg IV dusky at distal end, and tibia and metatarsus of leg IV also blackish at distal end. Abdomen with dorsum black crossed with a submedian and an anterior transverse white stripe and with a white T-shaped mark between the two stripes and connected with submedian one; venter white over middle region, laterally black as are also the sides. Spinnerets also blackish.

Anterior tarsi and metatarsi scopulate, the posterior tarsi alone scopulate. Ventral spines of tibia I, 0-0-1; of tibia II, 0-1-1; the corresponding tarsi with the usual pair of subbasal ventral spines.

In the female the posterior row of eyes recurved as usual; eyes subequal, the medians separated from each other by about their radius, twice as far from the laterals. Anterior median eyes much smaller than the laterals, about their radius apart. Area of median eyes scarcely wider behind than in front, and scarcely longer than wide. In the male the posterior median eyes are relatively farther apart, while the anterior median eyes are relatively larger and obviously closer together.

Palpus of male and epigynum of female as figured.

Length of female, 6.46 mm. Length of cephalothorax, 2.90 mm.; width, 2.00 mm. Tibia + patella I, 2.29 mm.; IV, 2.50 mm.

Length of male, 6.00 mm. Length of cephalothorax, 2.83 mm., width, 1.87 mm. Length of tibia + patella I, 2.00 mm.; IV, 2.50 mm.

LOCALITY.—Texas: Edinburg. One male (holotype) and female allotype and paratype taken September 18, 1935, by Mr. Stanley Mulaik. Two female paratypes from northwest of Edinburg, June 15, 1935 (S. Mulaik).

### *NODOCION CHAMBERLIN*

### *Nodocion moronius*, new species

Figure 21

FEMALE.—Carapace and sternum shining brownish black. Legs blackish over brown, with the tarsi, and sometimes also metatarsi, paler. Abdomen black over brown as usual, the latter showing more abundantly on venter as usual.

Scopula of tarsus I rather sparse, that of the metatarsus especially so. Spines of leg I uncertain because of rubbed condition of specimen.

Upper margin of furrow of chelicera with three teeth, the lower with none.

Posterior row of eyes nearly straight; median eyes much larger than the laterals, subcircular, nearly contiguous with each other, separated from the laterals by rather less than the radius of the latter. Anterior median eyes much smaller than the laterals, slightly less than their diameter apart. Area of median eyes much wider behind than in front (3:2), about equal in length and width behind. Epigynum figured.

Length, 4.70 mm. Length of cephalothorax, 1.74 mm.; width, 1.30 mm. Tibia + patella I, 1.39 mm.; IV, 1.74 mm.

LOCALITY.—Utah: Moroni. One female (holotype) taken June 12, 1927, by R. V. Chamberlin. In University of Utah collection.

### *Nodocion zelotoides*, new species

Figure 20

FEMALE.—Carapace and chelicerae dusky over brown. Sternum clearer brown. Legs brown of a lighter shade. Abdomen dark gray or blackish above, lighter beneath. Spinnerets yellowish, a little dusky.

Lower margin of furrow of chelicera without teeth, the chitinous ridge of the upper margin broken into 5 denticulations more distinct than usual.

Posterior row of eyes a little longer than the anterior row, a little procurved; median eyes smaller than usual, approaching the usual *Zelotes* proportions, not larger than the laterals, oblique, being a little longer in the cephalo-ectal meso-caudal direction, about their longer radius apart and about the same distance from the laterals. Anterior median eyes much smaller than the laterals (cir. 7:9), about five-sevenths their diameter apart, very close to the laterals. Area of median eyes scarcely longer than wide and slightly wider behind than in front (17:16). Epigynum as drawn.

Length, 6.74 mm. Length of cephalothorax, 2.83 mm.; width, 2.10 mm. Tibia + patella I, 2.90 mm.

(Fourth legs missing from holotype.)

LOCALITY.—Texas: Green Island Bird Refuge. One female (holotype) taken by S. Mulaik, May 4, 1935.

This species is atypical in the smaller size of the posterior median eyes and their relatively wider separation, in these respects suggesting *Zelotes*, although these eyes are of the typical shape and obliquity. The epigynum is distinctly of the *Nodocion* form as typified in *N. barbaranus* (see Fig. 19).

### GNAPHOSA LATREILLE

### *Gnaphosa mulaiki*, new species

Figure 24

FEMALE.—Carapace, chelicerae and sternum yellowish brown, the legs clearer yellow. Abdomen gray, lighter beneath than above, the spinnerets yellowish.

Tarsi I and II scopulate as also are, more sparsely, the corresponding metatarsi

over their distal portions. Tibiae I and II without spines. Metatarsus I without spines, II with a single subbasal ventral spine.

Posterior row of eyes recurved as usual, much longer than the anterior row; median eyes somewhat triangular in outline but with the angles well rounded and the sides bulging, smaller than the laterals, slightly more than their longer radius apart and about once and a half their diameter from the laterals. Anterior median eyes smaller than the laterals (diameters cir. as 7:9), a little more than their radius (four-sevenths) from each other. Area of median eyes as wide in front as behind and as wide as long. Epigynum as figured.

Length, 5.50 mm. Length of cephalothorax, 2.50 mm.; width, 1.95 mm. Length of tibia + patella I, 2.00 mm.; IV, 2.56 mm.

LOCALITY.—Texas, Green Island Bird Sanctuary. One female (holotype) taken May 11, 1935, by Stanley Mulaik.

#### ORODRASSUS CHAMBERLIN

##### *Orodassus coloradensis* (Emerton)

Figure 23

*Drassus coloradensis* EMERTON, 1877, Bull. U. S. Geol. Survey, III, p. 528.

*Teminius continentalis* KEYSERLING, 1887, Verh. Zool.-Bot. Gesell. Wien, p. 423, Fig. 2.

*Drassodes melius* CHAMBERLIN, 1912, Ann. Ent. Soc. America, XII, p. 246, Pl. xvi, Figs. 4 and 5.

RECORD.—Montana: Ravalli Co., Skalkabo Canyon. Two females taken by William Jellison, October 10, 1934.

##### *Orodassus durranti*, new species

Figure 22

FEMALE.—Carapace brown with dusky lateral borders and some dark reticulate lines on head region running forward from an obscure, somewhat shield-shaped, area in front of the dorsal stria. Chelicerae, labium and endites chestnut, the sternum of a lighter cast. Legs yellowish proximally, the distal articles more chestnut. Abdomen dark brown above, lighter brown beneath.

All tarsi densely scopulate. Anterior metatarsi also scopulate over entire length, the posterior metatarsi only over more distal portion. Tibia I without spines, II with a single ventral spine distad of middle. Posterior tibiae without median dorsal spines as usual.

Posterior row of eyes scarcely procurved; median eyes circular, about equal in size to the laterals and much smaller than the anterior medians (diameter about as 2:3), about once and a fifth their diameter apart and farther from the laterals. Anterior median eyes as large as the laterals or nearly so, their radius apart. Area of median eyes nearly as long as wide and equal in width anteriorly and posteriorly.

Characterized by the form of the epigynum which is illustrated.

Length, 9.00 mm. Length of cephalothorax, 4.50 mm.; width, 3.20 mm. Tibia + patella I, 4.10 mm.; IV, 4.20 mm.

LOCALITY.—California: Donner's Pass. Female holotype collected August 23, 1932, by S. D. Durrant. In University of Utah collection.

## DRASSODES WESTRING

*Drassodes robinsoni* Chamberlin

*Drassodes robinsoni* CHAMBERLIN, 1919, Ann. Ent. Soc. America, XII, p. 245, Pl. XVI, Fig. 2.

RECORD.—Texas: Mt. Locke Observatory. One female taken July 5, 1934, by Stanley Mulaik.

## HAPLODRASSUS CHAMBERLIN

*Haplodrassus admes* Chamberlin

*Haplodrassus admes* CHAMBERLIN, 1922, Proc. Biol. Soc. Washington, XXXV, p. 162.

RECORD.—New Mexico: fifteen miles northeast of Taos, elevation 7000 feet. One female taken by A. C. Cole. Previously known from Arizona.

## ZELOTES GISTL

*Zelotes duplex* Chamberlin

*Zelotes duplex* CHAMBERLIN, 1922, Proc. Biol. Soc. Washington, XXXV, p. 164.

RECORD.—North Carolina: Base of Mt. Leconte. One female taken September 9–10, 1929, by Dr. W. M. Barrows.

*Zelotes anthereus*, new species

Figures 37, 38, and 39

MALE.—Carapace shining brownish black, the latter color appearing under the lens in the usual reticulations. Sternum dusky chestnut. Legs dusky brown, the tarsi and metatarsi clearer brown. Abdomen dark brownish gray or blackish above, light beneath.

Scopulae of legs typical, being present on tarsi and metatarsi I and II, while posterior tarsi are simply setose. Tibiae I and II without spines. Metatarsus I without spines; metatarsus II with a pair of ventral spines toward base.

Lower margin of furrow of chelicera with two nodular teeth of which the caudal is sometimes obscure; upper margin with four distinct teeth.

Posterior row of eyes essentially straight; eyes subequal, the medians a little nearer to each other than to the laterals. Anterior median eyes greatly exceeded by the laterals (diameter nearly as 5:8), separated from each other by about three-fifths their diameter, nearly touching the laterals. Area of median eyes clearly wider behind than in front (cir. 7:5), and about as wide behind as long. Palpus as figured.

Length, 4.80 mm. Length of cephalothorax, 2.52 mm.; width, 1.70 mm. Tibia + patella I, 2.26 mm.; IV, 2.40 mm.

FEMALE.—Epigynum of the typical general form for the genus as shown in Fig. 39.

Length of allotype, 6.00 mm. Length of cephalothorax, 2.70 mm.; width, 1.90 mm. Tibia + patella I, 2.30 mm.; IV, 2.70 mm.

LOCALITY.—California: Berkeley. Two males (holotype and paratype), female (allotype) and several immature specimens taken in December, 1919. Holotype and allotype in University of Utah collection, male paratype in the American Museum.

*Zelotes lymnophilus*, new species

Figure 47

FEMALE.—Carapace black in reticulations over brown. Sternum brown. Chelicerae yellow with some dark markings in front. Coxae of legs also yellow edged distally with black; trochanters and tarsi yellow, the intervening joints mostly blackish. Dorsum of abdomen black, with brown showing in small spots, the venter yellowish gray.

Tarsi I and II scopulate, the corresponding metatarsi with scopular hairs distally. Posterior tarsi setose excepting for a group of scopular hairs at distal end beneath claws.

Tibia I with ventral spines 2-2-0, metatarsi I and II also with ventral spines 2-2-0.

Lower margin of furrow of chelicera with three teeth, the upper with four.

Posterior row of eyes slightly procurved; eyes equidistant, or the medians but little nearer each other than to the laterals; the medians scarcely smaller than the laterals, oblong and oblique. Anterior median eyes very much smaller than the laterals, about their diameter apart. Area of median eyes wider behind than in front. Epigynum figured.

Length, 3.13 mm. Length of cephalothorax, 1.39 mm.; width, 1.09 mm. Tibia + patella I, 1.13 mm.; IV, 1.39 mm.

LOCALITY.—Georgia: Okefenokee Swamp. One female in the University of Utah collection.

*Zelotes monodens*, new species

Figure 36

FEMALE.—Carapace black over brown, the black denser in a subpentagonal area in front of the median furrow and in reticulations elsewhere over entire surface. Sternum also nearly black. Legs with femora, patellae and tibiae black, the coxae also blackish above, somewhat paler beneath, the tarsi and metatarsi yellowish. Abdomen above and the spinnerets black, the venter light gray.

Anterior tarsi scopulate as usual, the metatarsi with sparse scopular hairs distally. No ventral spines could be detected in holotype either on tibiae I and II or on the corresponding metatarsi.

Posterior row of eyes nearly straight, longer than the anterior row (27:24); eyes nearly equidistant, the medians smaller than the laterals. Anterior median eyes more than their radius apart, close to laterals, than which they are much smaller. Area of median eyes a little longer than wide and a little wider behind than in front (cir. 8:7).

Lower margin of furrow of chelicera with only one tooth, the upper with four. Epigynum as figured.

Length, 3.50 mm. Length of cephalothorax, 1.35 mm.; width, 1.00 mm. Length of tibia + patella I, 1.20 mm.

LOCALITY.—Texas: Edinburg. One female (holotype) taken May 2, 1935, by S. Mulaik.

*Zelotes nannodes*, new species

Figure 35

FEMALE.—A species lighter in color than usual in the genus. Carapace yellow, dusky along lateral borders and in reticulations as usual, three longitudinal dark marks in front of stria united behind and outlining the typical shield-shaped area. Chelicerae, sternum and legs clear yellow. Abdomen light gray above and paler beneath.

Anterior tarsi and metatarsi scopulate, the scopular hairs not dense, especially sparse on the metatarsi. Posterior tarsi simply setose. Tibiae I and II and also the corresponding metatarsi without spines.

The teeth of the chelicerae difficult to see in the holotype because of small size and pale color. Seemingly there is one tooth or nodule on lower margin of furrow and four on upper margin.

Posterior row of eyes nearly straight; median eyes slightly smaller than the laterals to which they are closer than to each other. Anterior median eyes very much smaller than the laterals, unusual in being decidedly more than their diameter apart. Epigynum as shown in the figure.

Length, 2.60 mm. Length of cephalothorax, 0.95 mm.; width, 0.70 mm. Tibia + patella I, 0.78 mm.; IV, 0.86 mm.

LOCALITY.—Utah: ten miles west of Tremonton. Female holotype taken by W. Ivie, June 8, 1931, under a rock on a dry hillside.

*Zelotes pananus*, new species

Figure 44

FEMALE.—Carapace with the usual reticulation of black over brown, the sternum similar. Coxae and femora of all legs likewise blackish, the more distal articles yellowish excepting on legs IV in which the tibia and metatarsus are also darkened in the holotype. Abdomen black above and over the sides, the venter paler because of the numerous small light spots in the area behind the genital furrow, in front of which the lighter color is continuous. Spinnerets dusky brown.

Tarsi and metatarsi I and II scopulate as usual. Tibiae I and II with ventral spines 0-1-1, the corresponding metatarsi each with a single ventral spine at base, all spines of these joints toward anterior side. Tibia III with a median dorsal spine at base.

Posterior row of eyes straight or very nearly so, the eyes subequal and equidistant. Anterior row of eyes shorter than posterior nearly as 13:16; median eyes much smaller than the laterals (diameters about as 5:8), about three-fifths their diameter apart, subcontiguous with the laterals. Area of median eyes about equal in length and breadth behind, wider behind than in front, nearly in ratio 8:7.

In the holotype one of the chelicerae is missing and teeth on the other could not be made out, probably having been rubbed off. Epigynum as figured.

Length, 5.43 mm. Length of cephalothorax, 2.50 mm.; width, 1.65 mm. Tibia + patella I, 1.90 mm.; IV, 2.26 mm.

LOCALITY.—Utah: City Creek Canyon. One female taken by W. Gertsch, June 12, 1928, and now in the University of Utah collection.

*Zelotes petrophilus*, new species

Figures 45 and 46

MALE.—Color nearly as in *Z. antereus*. Scapulae and spining of legs also as in *Z. antereus*.

Upper margin of furrow of chelicera with three teeth, the lower with one.

Posterior row of eyes straight; median eyes slightly smaller than the laterals, somewhat oblong and obliquely set, two-thirds their long diameter apart and five-sixths that diameter from the laterals. Anterior median eyes relatively larger than in *antereus*, (diameter nearly as 3:4), nearly two-thirds their diameter apart. Area of median eyes wider behind than in front (17:15), and about as wide behind as long. Palpus as figured.

Length, 6.75 mm. Length of cephalothorax, 3.26 mm.; width, 1.90 mm. Length of tibia + patella I, 3.70 mm.; IV, 3.70 mm.

LOCALITY.—California: Petrified Forest. One male (holotype) and an immature female taken by W. Ivie, August 27, 1931.

*Zelotes shoshoneus*, new species

Figures 42 and 43

MALE.—Carapace blackish in obscure reticulations over a brown ground. Sternum brown of a reddish cast. Legs brown with especially the femora and less strongly the patellae and tibiae blackish or dusky. Abdomen dusky brown above; venter lighter, gray in color. Spinnerets dusky or blackish.

Tarsi and distal portion of metatarsi of legs I and II scopulate, the posterior tarsi setose. Tibiae and metatarsi I and II without spines. Posterior tibiae not dorsally armed.

Posterior row of eyes only very slightly procurved; eyes subequal, the medians about four-fifths their diameter apart, somewhat closer to the laterals. Anterior median eyes with diameter about five-sixths that of the laterals, about four-fifths their diameter apart, and nearly contiguous with the laterals. Posterior row longer than the anterior in about the ratio 13:11.

Chelicerae with lower margin of furrow armed with one small tooth; the upper margin with two larger teeth proximad of which is a low chitinous ridge not broken into denticles. In one specimen only one tooth is present on upper margin, the proximal one apparently may have been broken off. Palpus as figured.

Length, 4.43 mm. Length of cephalothorax, 1.82 mm.; width, 1.40 mm. Tibia + patella I, 1.20 mm.; IV, 1.82 mm.

LOCALITIES.—Idaho: Burley, one male (holotype) taken June 4, 1931, by Wilton Ivie.—Washington: Friday Harbor, one male (paratype) taken in the summer of 1924.—Colorado: Valmont, one male (paratype) taken April 27, 1923, by H. G. Rodeck.



The holotype and first paratype are in the collection of the University of Utah, the second paratype in the American Museum.

***Zelotes cymbiolus*, new species**

Figures 40 and 41

MALE.—Carapace blackish over brown, the black being more solid over the lateral borders. Chelicerae dusky. Sternum yellow. Palpi with proximal joints yellow, the tibia and tarsus dusky. Legs blackish except coxae and tarsi, which show more yellow though also more or less irregularly dusky over the lighter background. Abdomen black above, dusky over a light background beneath, the spinnerets black.

Anterior tarsi scopulate, the posterior ones setose. Tibia I with ventral spines 2-2-0; tibia II with ventral spines 1-1-0, the spines being toward the caudal edge. Metatarsi I and II with 2-2-0 ventral spines.

Lower margin of furrow of chelicera with 2 teeth; the upper with 4.

Posterior row of eyes slightly procurved; the medians a little smaller than the laterals, a little oblong, oblique, nearly their radius apart, a little farther from the laterals. Anterior median eyes nearly three-fifths the diameter of the laterals, a little less than their diameter apart, much closer to the laterals. Area of median eyes slightly longer than wide, slightly wider behind than in front. Palpus as figured.

Length, 3.00 mm. Length of cephalothorax, 1.43 mm.; width, 1.20 mm. Tibia + patella I, 1.65 mm.; IV, 1.90 mm.

LOCALITY.—Florida: Alachua County. One male (holotype) taken April 14, 1934, by Mr. H. K. Wallace.

**DRASSYLLUS CHAMBERLIN**

***Drassyllus eremitus* Chamberlin**

*Drassyllus eremitus* CHAMBERLIN, 1922, Proc. Biol. Soc. Washington, XXXV, p. 167.

RECORD.—Florida: Jackson County. One female taken April 12 1935.

***Drassyllus femoralis* (Banks)**

*Zelotes femoralis* BANKS, 1904, Proc. California Acad. Sci. (3), III, p. 336, Pl. XXXVIII, fig. 1.

*Drassyllus femoralis* CHAMBERLIN, 1922, Proc. Biol. Soc. Washington, XXXV, p. 170.

RECORD.—Arizona: Tucson. One female taken in August, 1935, by Mr. Peter Steckler.

***Drassyllus niger* (Banks)**

*Prothesima niger* BANKS, 1896, Trans. Amer. Ent. Soc., p. 62; 1900, Proc. Washington Acad., II, p. 478.

*Drassyllus niger* CHAMBERLIN, 1922, Proc. Biol. Soc. Washington, XXXV, p. 170.

RECORD.—New Jersey: Ramsey. One female taken June 2, 1934, by W. J. Gertsch.

***Drassyllus orgilus* Chamberlin**

*Drassyllus orgilus* CHAMBERLIN, 1922, Proc. Biol. Soc. Washington, XXXV, p. 169.

RECORDS.—Texas: Brazos County, one female taken by J. H. Robinson, Jan. 28, 1935; Laredo, one female taken Feb. 9, 1935, by S. Mulaik; thirty miles west of Edinburg, a female taken Nov. 24, 1934, by S. Mulaik.

Previously known from Austin, Texas.

***Drassyllus dentelifer*, new species**

Figures 1 and 2

MALE.—Carapace and chelicerae dusky brown. Legs lighter excepting I and II in which the femur, patella and tibia are black. Sternum and coxae of legs yellow. Abdomen black above; a basal scutellar area detectable; venter paler, yellowish, slightly dusky. Spinnerets yellow.

Upper margin of furrow of chelicera with four (4) teeth, (or a minute fifth one also present), the lower margin with two (2) teeth.

In the type no scopular hairs are present on any of the tarsi, and if present in life have been lost. Tibiae I and II without spines, the corresponding metatarsi with a pair of subbasal ventral spines. Posterior tibiae with a median dorsal spine.

Posterior row of eyes procurved; median eyes very large, much exceeding the laterals, somewhat angular, contiguous with each other, their contiguous edges flattened or straight, also very close to the laterals. Anterior row of eyes conspicuously procurved; medians much smaller than the laterals (diameter about as 5:8). Lateral eyes on each side with posterior eye decidedly smaller than the anterior one, scarcely the radius of the former apart. Area of median eyes equal in width behind and in front, longer than wide (ad. 17:14).

Major spinning tubules of anterior spinnerets four in number. Palpus as shown in the figures.

Length, 4.37 mm. Length of cephalothorax, 2.08 mm., width, 1.54 mm. Length of tibia + patella I, 1.87 mm.; of tibia + patella IV, 2.08 mm.

LOCALITY.—Florida: Gainesville. One male (holotype) taken April 17, 1933, by H. K. Wallace.

***Drassyllus deveexus*, new species**

Figure 7

FEMALE.—Carapace, chelicerae, sternum and legs yellow, without markings.

Scopulae of anterior tarsi sparse, none on posterior tarsi. Tibiae I and II with ventral spines 1-1-0, the distal one replaced by a long seta. Metatarsus I with a pair of subbasal ventral spines, II with the same and in addition a single spine toward distal end. Posterior tibiae without a median dorsal spine.

Upper margin of furrow of chelicera with five (5) teeth, the lower with two (2).

Posterior row of eyes procurved; median eyes oblique and slightly angled, larger than the laterals, separated from each other by considerably less than a radius and closer to the laterals. Anterior median eyes smaller than the laterals, separated by their radius or more, much closer to the laterals. Area of median eyes of same width in front and behind, decidedly longer than wide (cir. 5:4). Epigynum as figured.

Length, 7.00 mm. Length of cephalothorax, 2.37 mm.; width, 1.90 mm. Length of tibia + patella I, 2.50 mm., of tibia + patella IV, 2.58 mm.

LOCALITY.—Utah: Pinecrest, Salt Lake County, female holotype collected by R. V. Chamberlin, August 26, 1931; Dry Canyon, female paratype collected by W. Ivie, October 15, 1932. University of Utah Collection.

### *Drassyllus fractus*, new species

Figure 6

FEMALE.—Carapace brown, without any definite dark markings, the sternum and legs somewhat lighter. Abdomen brownish gray above, paler beneath, the spinnerets yellow.

Tarsi I and II, and the distal end of metatarsus I scopulate about as usual, the posterior legs without true scopulae. Tibiae I and II without spines. Metatarsus II with a pair of small, subbasal ventral spines but neither spines present nor indications that such have been present on metatarsus I of the type. Tibia III with no median dorsal spine, but tibia IV with a submedian dorsal spine toward base.

Posterior row of eyes procurved; median eyes obliquely elongate, larger than the laterals, less than their longer radius apart and nearly contiguous with the laterals. Anterior row of eyes procurved as usual; the median decidedly smaller than the laterals, decidedly less than their radius apart, closer to the laterals. Area of median eyes much wider behind than in front (7:5), about equal in length to the width behind. Readily distinguished by the epigynum.

Length, 3.40 mm. Length of cephalothorax, 1.75 mm.; width, 1.16 mm. Length of tibia + patella I, 1.66; of tibia + patella IV, 1.75 mm.

LOCALITY.—California: Friant. One female (holotype) taken in March, 1913 (R. V. Chamberlin).

### *Drassyllus mephisto*, new species

Figures 3, 4, and 5

MALE.—A very conspicuously colored species. Carapace yellow of a chestnut cast, the posterior lateral margins lined with black. Sternum yellow, with blackish margin. Legs yellow except that the anterior pairs have the tibia and patella and the distal portion of the femur, especially above, solid black. Abdomen black above, the black area on the yellowish scutellate area in front narrowed to a median band and crossed at middle by a now light transverse band which is interrupted at the middle; sides whitish; venter black excepting a light area just back of the furrow and at sides in front. Spinnerets yellow.

None of the tarsi or metatarsi truly scopulate. Tibia I without spines; II with

ventral spines 1-1-0. The anterior metatarsi with the usual pair of ventral spines toward base. Posterior tibiae without median dorsal spine.

Posterior row of eyes procurved, medians unusually large, greatly exceeding the laterals, obliquely elongate, elliptical, in contact mesocaudally, a little removed from the laterals. Anterior median eyes much smaller than the laterals (diameters cir. 7:9), nearly their radius apart.

Upper margin of furrow of chelicera with five (5) teeth of which the two most distal are much reduced, the lower margin with four (4) teeth or nodules.

Length, 4.00 mm. Length of cephalothorax, 1.83 mm.; width, 1.46 mm. Tibia + patella I, 1.84 mm.; tibia + patella IV, 2.00 mm.

**FEMALE.**—The female allotype has the cephalothorax, etc., lighter in color, yellow, but the striking color markings are identical and the eyes are also as in the male. Epigynum as figured.

**LOCALITIES:** Texas: Edinburg. One adult male (holotype) and five immature females taken January 8, 1934.—Utah: Washington County, Pine Valley Mountains, one female (allotype) taken in July, 1935, by Rex Snow. The holotype in American Museum, allotype in University of Utah collection.

#### *Drassyllus abdalbus*, new species

Figures 31 and 32

**MALE.**—Carapace, chelicerae, palpi and sternum light chestnut. Anterior legs missing from holotype, the posterior pairs yellow in color. Abdomen entirely white except for a triangular area at base above which is light chestnut.

Posterior tibiae without median dorsal spines; tarsi not scopulate but clothed with setae.

Posterior row of eyes longer than the anterior, procurved; median eyes greatly exceeding the laterals in size (diameter about as 4:3), subcircular, somewhat angled, a little narrowed mesocaudally where they are contiguous, separated from the laterals by less than the radius of the latter. Anterior median eyes smaller than the laterals (cir. 3:4), not fully their radius apart, closer to the laterals as usual. Area of median eyes equal in length and breadth behind, and wider behind than in front (10:9). Palpus as illustrated.

Length, 6.50 mm. Length of cephalothorax, 3.00 mm., width, 2.40 mm. Tibia + patella IV, 3.20 mm.

**LOCALITY.**—Arizona: Tucson. One male (holotype) taken in Aug., 1935, by P. Steckler.

#### *Drassyllus finium*, new species

Figures 33 and 34

**MALE.**—Carapace dusky yellow, darker along margins, the sternum clearer yellow. Legs yellow with first pair having femur, patella and tibia darkened. Abdomen dark gray or blackish above, paler beneath.

Tibiae I and II without spines, the corresponding metatarsi armed at base in the usual way. Posterior tibiae without median dorsal spine.

Lower margin of furrow of chelicera with 3 teeth, the upper with a series of about 8 denticles.

Posterior row of eyes conspicuously procurved; median eyes oblique, subovate, with narrower end mesocaudal in position, contiguous at one point, being tangent to the median line, narrowly separated from the lateral eyes. Anterior median eyes much smaller than the laterals (cir. 5:7), a little more than their radius apart. Area of median eyes much longer than wide (cir. 4:3), and wider behind than in front (6:5). Palpus as figured.

Length, 3.48 mm. Length of cephalothorax, 1.43 mm.; width, 1.09 mm. Tibia + patella I, 1.43 mm.; IV, 1.52 mm.

LOCALITY.—Texas, Sonora. One male (holotype) taken May 3, 1926, by F. C. Bishopp.

### *Drassyllus gynosaphes*, new species

Figures 26, 27, and 28

FEMALE.—Carapace yellow, dusky along the lateral borders and in obscure reticulations elsewhere. Sternum and legs yellow, the anterior pairs of the latter dusky over femora, patella and tibia. Abdomen black dorsally, lighter beneath, especially in front of genital furrow.

Tibiae I and II without spines, the corresponding metatarsi with a pair of sub-basal ventral spines. Posterior tibiae with no middorsal spine. Anterior tarsi sparsely scopulate, the posterior tarsi simply setose.

Lower margin of furrow of chelicera with three denticles, the upper margin with four teeth of which the next to the most caudal is much the largest.

Posterior row of eyes slightly procurved; median eyes broadly suboblong, the corners rounded, oblique, in contact with each other at their mesocaudal corners, their long diameter not or scarcely exceeding the diameter of the laterals. Anterior median eyes much smaller than the laterals, nearly their diameter apart. Area of median eyes longer than wide (cir. 5:4), equal in width behind and in front. Epigynum as figured.

Length, 3.90 mm. Length of cephalothorax, 1.74 mm.; width, 1.30 mm. Tibia and patella I, 1.74 mm.; IV, 1.96 mm.

MALE.—Coloration as in the female, chelicerae the same and eyes also nearly the same. Tibia I with a submedian ventral spine. Epigynum as figured.

Length, 3.90 mm. Length of cephalothorax, 1.70 mm.; width, 1.26 mm. Tibia + patella I, 1.87 mm.; IV, 1.90 mm.

LOCALITY.—Texas: Edinburg. One female (holotype) and two males (allotype and paratype) collected in April, 1934, by S. Mulaik.

### *Drassyllus prosaphes*, new species

Figures 29 and 30

MALE.—Lower margin of furrow of chelicerae with 2 teeth, the upper with four.

Carapace dusky yellow, the lateral margins bordered with black, and a black area in region of median stria extended along caudal margins of pars cephalica. Sternum yellow. Legs yellow, with distal end of femur and all of patella and tibia of

legs I and II blackish or dusky. Abdomen dark gray or blackish above, somewhat lighter below, yellowish in front of genital furrow.

Tarsi setose beneath, none truly scopulate. Tibia I with no spines, II with a submedian ventral spine. Metatarsi spined at base as usual. Leg III missing from holotype, IV without median dorsal spine.

Posterior row of eyes with usual procurvature, a little longer than the anterior row; median eyes much larger than the laterals, diameters rather more than 6:5, oblique, the mesocaudal end moderately narrowed, touching each other, narrowly separated from the laterals. Anterior median eyes much smaller than the laterals (diameters nearly as 2:3). Area of median eyes longer than wide (about as 13:11), wider behind than in front (11:10). Palpus as figured.

Length, 7.83 mm. Length of cephalothorax, 3.70 mm.; width, 2.83 mm. Tibia + patella I, 3.26 mm.; IV, 3.47 mm.

LOCALITY.—Texas: Edinburg. One male (holotype) taken by S. Mulaik, May 2, 1935.

### *Drassyllus texamans*, new species

#### Figure 25

FEMALE.—Carapace, sternum and legs yellow, the carapace and anterior legs dusky. Abdomen dark gray or blackish above, light gray below.

Tarsi rather sparsely scopulate, the metatarsi not scopulate. No spines detectable on anterior tibiae, the metatarsi each with a pair of small spines at base. Tibiae III and IV without any median dorsal spine. Lower margin of furrow of chelicerae with 3 teeth, the upper with 4.

Posterior row of eyes procurved as usual, median eyes oblique, moderately narrowed mesocaudad, their long axes meeting at nearly a right angle, contiguous with each other and also very close to the laterals which are smaller (long diameter of medians to diameter of laterals about as 5:4). Anterior row of eyes shorter than the posterior; median eyes much smaller than the laterals (diameters nearly as 3:5), about two-thirds their diameter apart and subcontiguous with the laterals. Area of median eyes wider behind than in front (cir. 6:5).

Characterized especially by form of epigynum, which is figured.

Length, 3.10 mm. Length of cephalothorax, 1.30 mm.; width, 1.00 mm. Tibia + patella IV, 1.35 mm.

LOCALITY.—Texas: Sanderson. One female (holotype) taken July 4, 1934, by S. Mulaik.

### *Drassyllus depressus* (Emerton)

*Prothesima depressa* EMERTON, 1909, Trans. Connecticut Acad., VIII, p. 173, Pl. III, Fig. 8.

*Prothesima depressa* EMERTON (in part), 1911, idem, XVI, p. 406, Pl. v, Fig. 8a, but not figures 8, 8b and 8c.

*Drassyllus depressus* CHAMBERLIN, 1922, Proc. Biol. Soc. Washington, XXXV, p. 167.

RECORD.—Michigan: Pine Lake, northeast of Lansing. One female taken June 20, 1921, by Dr. W. M. Barrows.

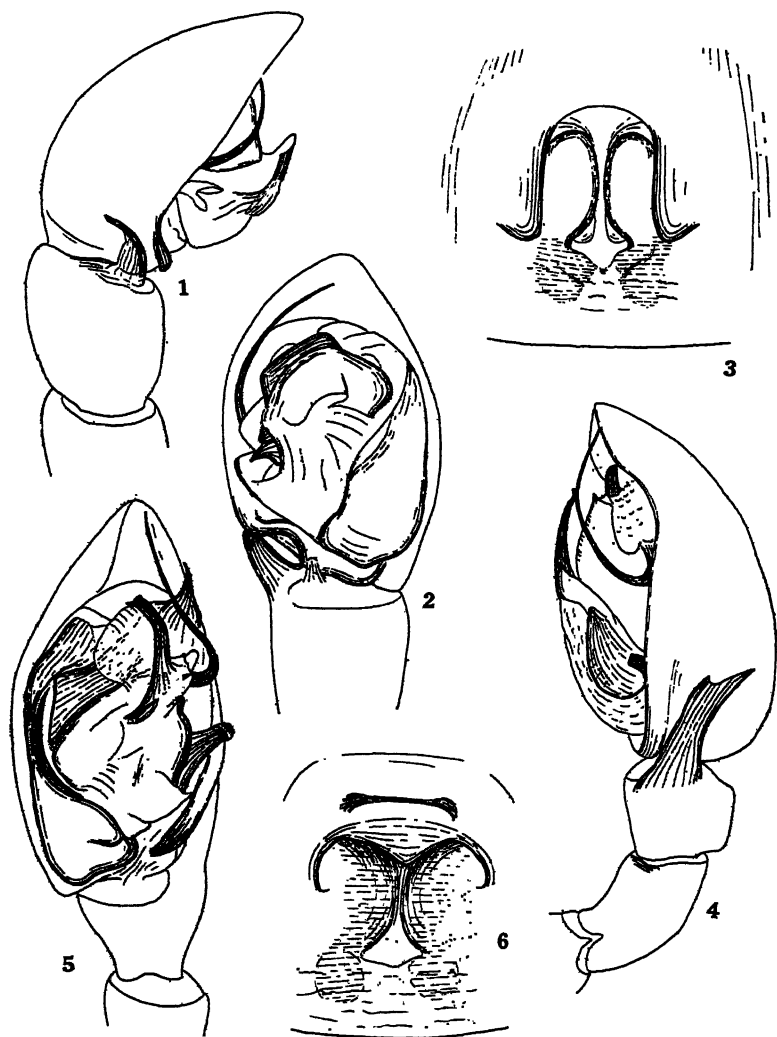
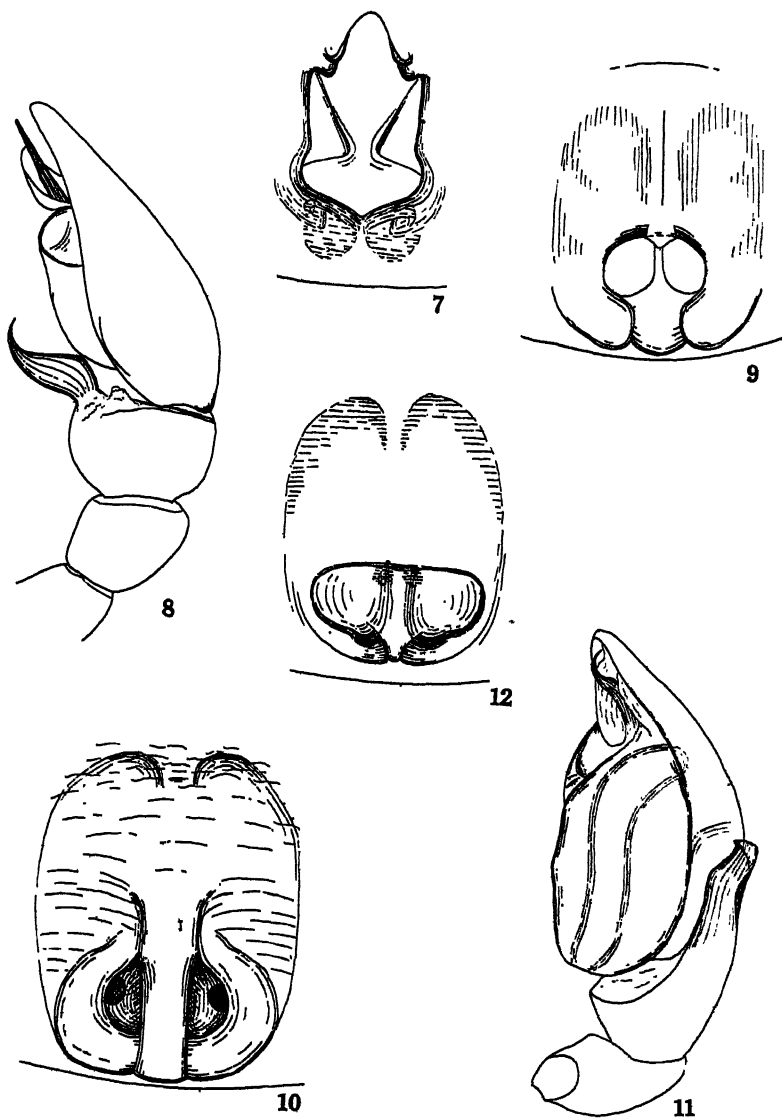


Fig. 1. *Drassyllus dentelifer*, new species, right palpus of male, ectal view.  
 Fig. 2. Idem, ventral view.  
 Fig. 3. *Drassyllus mephisto*, new species, epigynum.  
 Fig. 4. Idem, left palpus of male, ectal view.  
 Fig. 5. Idem, ventral view.  
 Fig. 6. *Drassyllus fractus*, new species, epigynum.



- Fig. 7. *Drassyllus deveexus*, new species, epigynum.  
 Fig. 8. *Herpyllus emertoni* Bryant, left palpus of male, ectal view.  
 Fig. 9. *Herpyllus bryophilus*, new species, epigynum.  
 Fig. 10. *Herpyllus itamus*, new species, epigynum.  
 Fig. 11. *Sergiolus segregatus*, new species, left palpus of male, ectal view.  
 Fig. 12. *Idem*, epigynum.



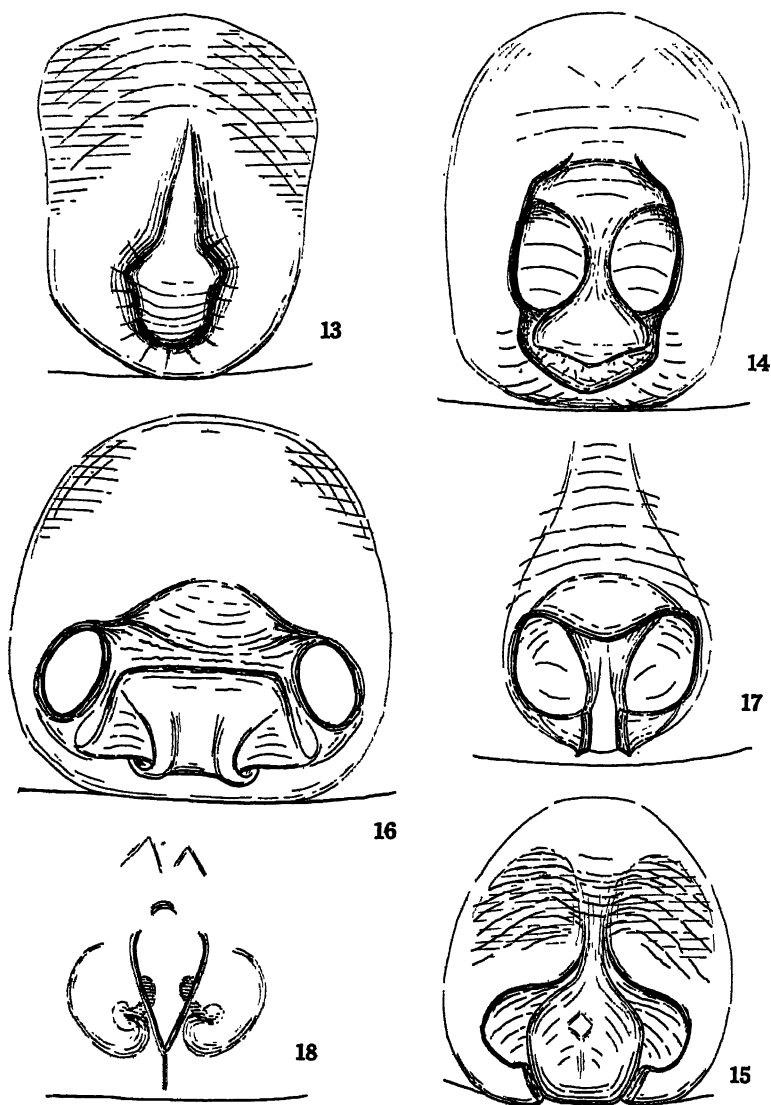
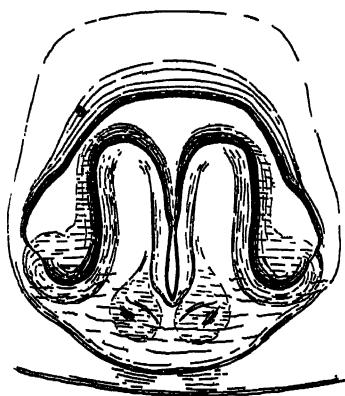
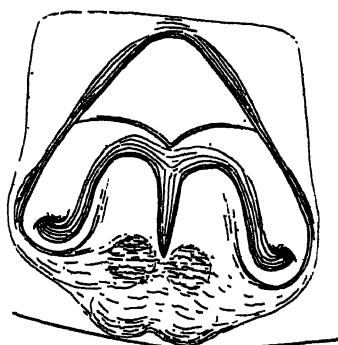


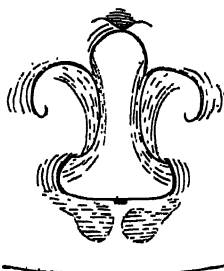
Fig. 13. *Herpyllus cepeus*, new species, epigynum.  
 Fig. 14. *Herpyllus regnans*, new species, epigynum.  
 Fig. 15. *Herpyllus reservatus*, new species, epigynum.  
 Fig. 16. *Liodrassus floridicolens*, new species, epigynum.  
 Fig. 17. *Sergiolus bellior*, new species, epigynum.  
 Fig. 18. *Sergiolus amphilogus*, new species, epigynum.



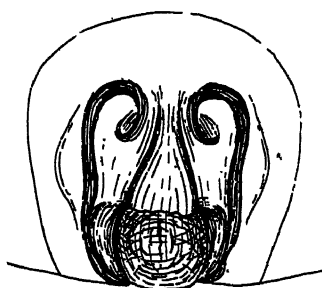
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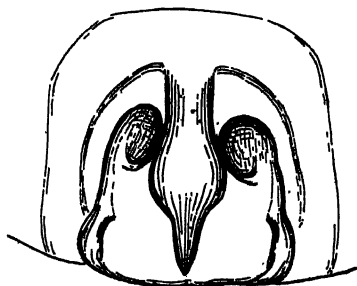
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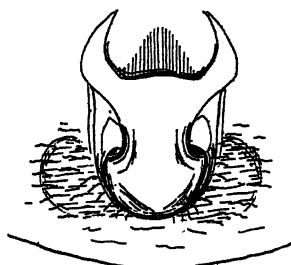
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Fig. 19. *Nodocion barbaranus* Chamberlin, epigynum of female from Tucson, Arizona.

Fig. 20. *Nodocion zelotoides*, new species, epigynum.

Fig. 21. *Nodocion moronius*, new species, epigynum.

Fig. 22. *Orodassus durranti*, new species, epigynum (distal portion of septum broken off).

Fig. 23. *Orodassus coloradensis* (Emerton), (variant), epigynum of a female from Washington State.

Fig. 24. *Gnaphosa mulaiki*, new species, epigynum.

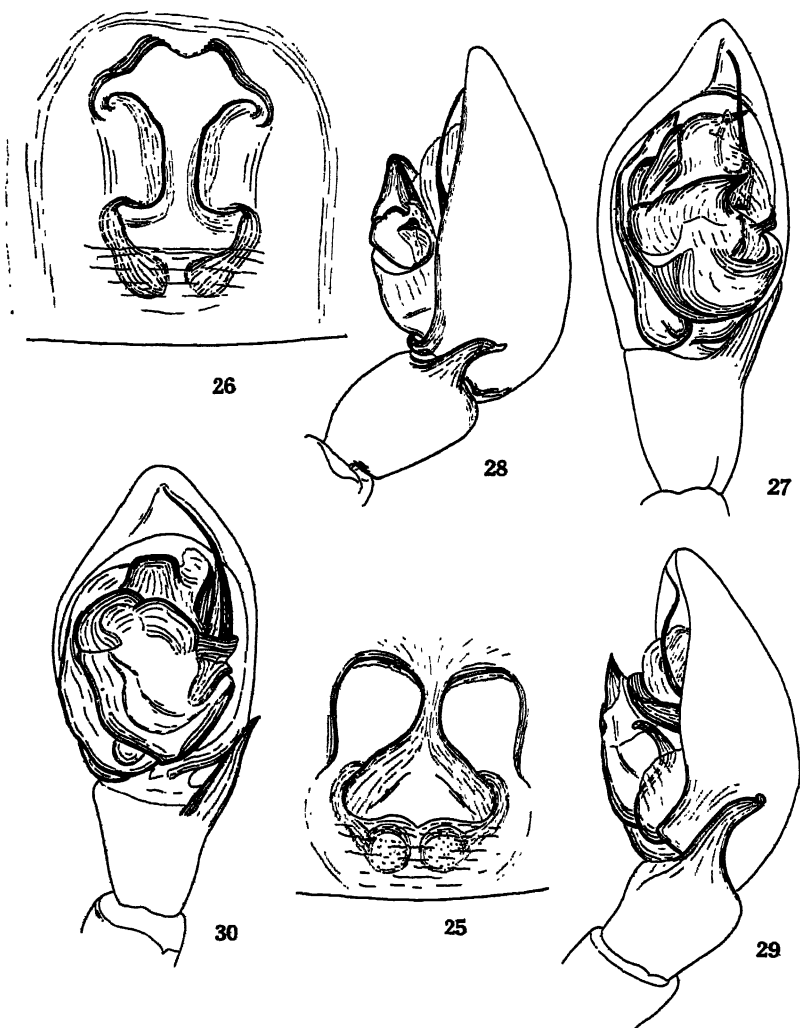


Fig. 25. *Drassyllus texamans*, new species, epigynum.  
 Fig. 26. *Drassyllus gynosaphes*, new species, epigynum.  
 Fig. 27. Idem, left palpus of male, ventral view.  
 Fig. 28. Idem, ectal view.  
 Fig. 29. *Drassyllus prosaphes*, new species, left palpus of male, ectal view.  
 Fig. 30. Idem, ventral view.

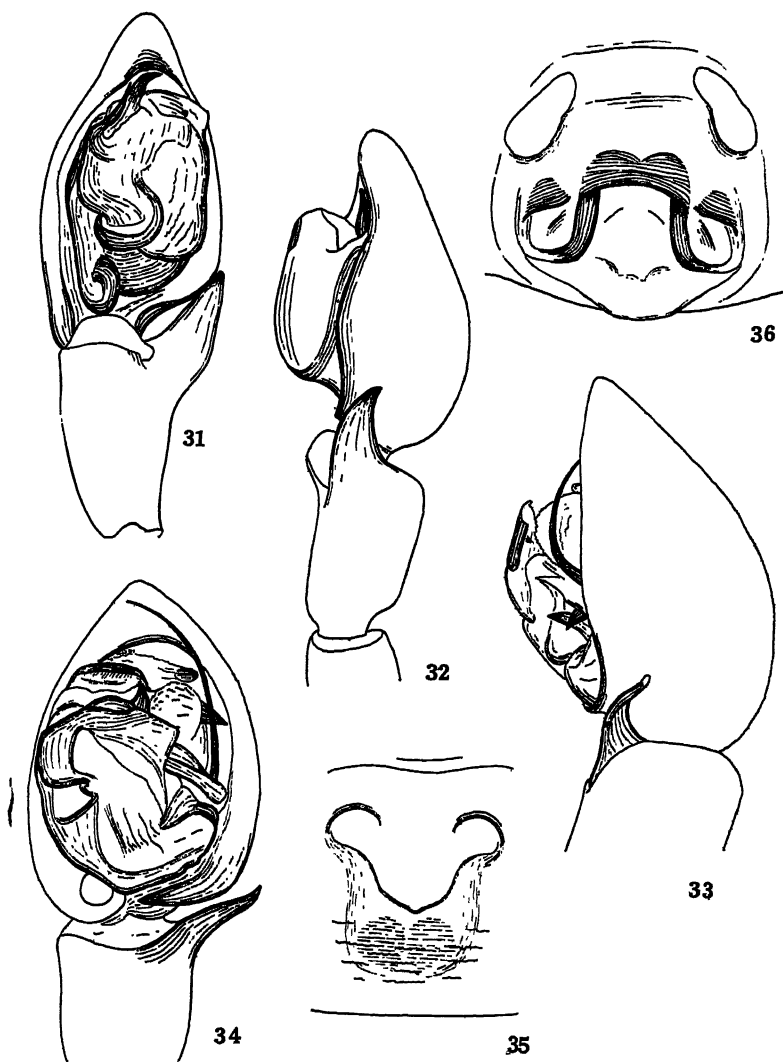
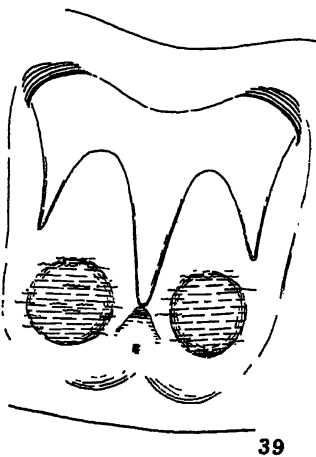
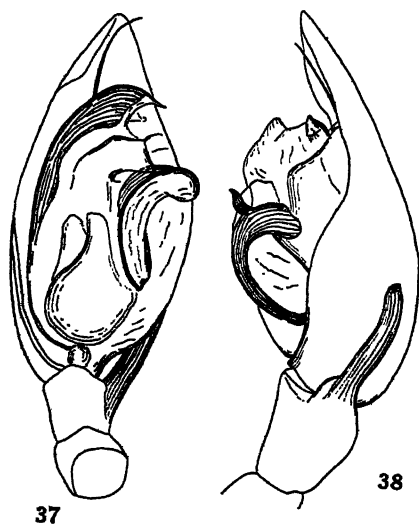
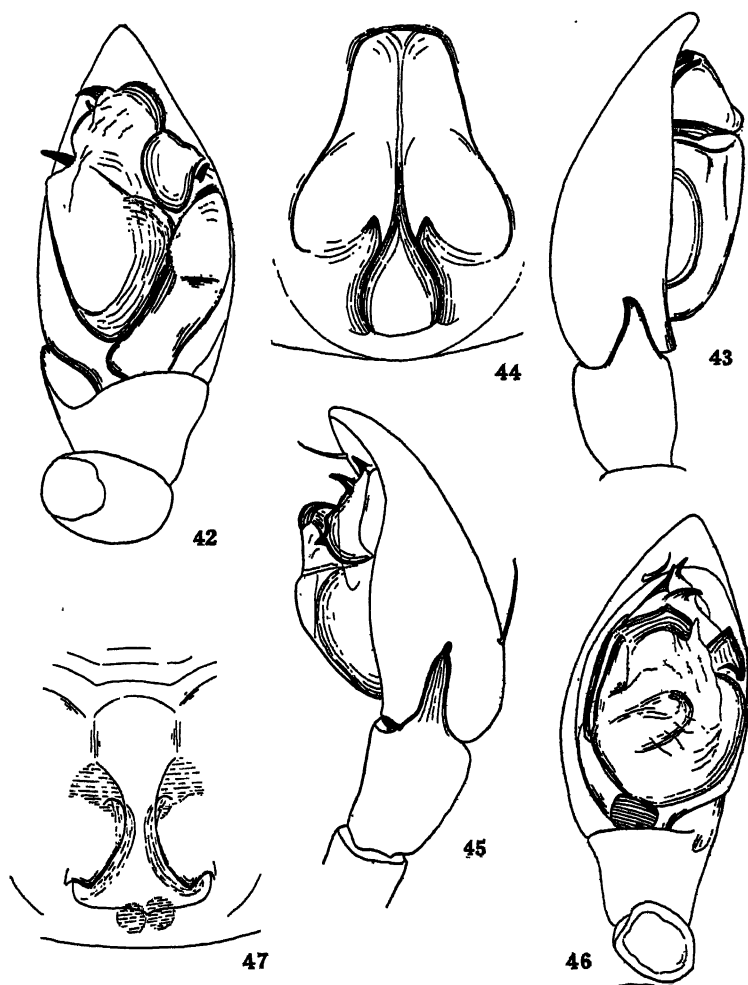


Fig. 31. *Drassyllus abdaltus*, new species, left palpus of male, ventral view.  
 Fig. 32. Idem, ectal view.  
 Fig. 33. *Drassyllus finium*, new species, left palpus of male, ectal view.  
 Fig. 34. Idem, ventral view.  
 Fig. 35. *Zelotes nannodes*, new species, epigynum.  
 Fig. 36. *Zelotes monodens*, new species, epigynum.



- Fig. 37. *Zelotes anthereus*, new species, left palpus of male, ectal view.  
 Fig. 38. Idem, ventral view.  
 Fig. 39. Idem, epigynum.  
 Fig. 40. *Zelotes cymbiolus*, new species, left palpus of male, ventral view.  
 Fig. 41. Idem, ectal view.



- Fig. 42. *Zelotes shoshoneus*, new species, right palpus of male, ventral view.  
 Fig. 43. Idem, ectal view.  
 Fig. 44. *Zelotes pananus*, new species, epigynum.  
 Fig. 45. *Zelotes petrophilus*, new species, left palpus of male, ectal view.  
 Fig. 46. Idem, ventral view.  
 Fig. 47. *Zelotes lynnophilus*, new species, epigynum.



# AMERICAN MUSEUM NOVITATES

Number 854

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

June 3, 1936

## TERTIARY DEER DISCOVERED BY THE AMERICAN MUSEUM ASIATIC EXPEDITIONS<sup>1</sup>

By EDWIN H. COLBERT

### INTRODUCTION

Among the fossils procured by the Central Asiatic Expeditions of The American Museum of Natural History are numerous small antlers, more or less complete, that would seem to be representative of several new types of deer. These fossils were found by the Expedition of 1930 in the Tung Gur formation of Upper Miocene age, and they all came from localities east of Iren Dabasu, just south of the boundary between Inner and Outer Mongolia.

The author wishes to express his indebtedness to Dr. Walter Granger, palaeontologist of the Central Asiatic Expeditions, for permission to study and describe these fossil deer.

### Subfamily Cervulinae

#### STEPHANOCERAS, NEW GENUS

*στεφανος* = a crown; *κερας* = horn.

An upper Tertiary cervuline of small size, characterized by a palmate antler with a moderately long pedicle. The antler may have but a few tines, or it may have several, projecting out from the palmate central portion. The genus is known from the antlers alone.

GENERIC TYPE.—*Stephanoceras thomsoni*.

#### *Stephanoceras thomsoni*,<sup>2</sup> new genus and species

Figures 1, 2, 3a-h 4, 5 and 7A

TYPE.—Amer. Mus. No. 26782, a right antler, complete except for the pedicle.

PARATYPES.—Amer. Mus. Nos. 26778, a right antler of a young individual; 26779, a right antler of a young individual; 26780, a left antler; 26781, a left antler; 26783, a left antler; 26784, a right antler; 26785, a right antler of an aged individual; 26786, a right antler; 26787, a left antler; 26788, a right antler; 26789, a left antler; 26790, several pedicles with fragments of antlers or frontlets attached; 26791, numerous fragmentary antlers; 26792, fragments of antlers.

HORIZON.—From the Tung Gur formation of Upper Miocene age.

LOCALITY.—All of the specimens came from one locality, about sixty miles east

<sup>1</sup> Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 131.

<sup>2</sup> Named in honor of Mr. Albert Thomson of The American Museum of Natural History, who was a member of the 1928 and 1930 field parties in Mongolia.



of Iren Dabasu on the Kalgan-Urga trail, and about twenty-five miles northeast of Gur Tung Khara Usu, Inner Mongolia.

DIAGNOSIS.—Antler broadly palmate with an average of six or eight tines in the adult. Antler supported on a rather long, heavy pedicle, which joins the antler in the middle of the palmate portion.

DESCRIPTION.—Unfortunately no skull bones or teeth were found, so that this genus and species are known from antlers only. There is, however, quite a large series of antlers in the collection made by the Asiatic Expedition, so we are able at least to obtain a very good knowledge of the variability and the age changes in the material at hand.

As set forth in the diagnosis of the genus and species, the antler is typically broadly palmate, set on a long pedicle. It may have a few tines, or it may have several, all projecting out from the palmate central portion of the antler. Invariably there is an anterior tine, one might call it a "brow tine" projecting outward and forward. The other tines are arranged around the edge of the palmate central portion of the antler, so that they project out in all directions. Posteriorly the palmate portion of the antler is continued back in line with the median axis, and it terminates in two points or tines. Thus the antler might be said to have a long antero-posterior axis, with a single outwardly directed brow tine at the front and a broad double pointed posterior termination, and with various tines arranged along either side. The numerous points or tines tend to curve up at their tips, and the palmate central portion of the antler is somewhat cup shaped, as if the entire structure were molded over an irregularly oblate spheroid. The pedicle is long, as compared to a typical cervid pedicle, but short, as compared to a cervuline pedicle.

DISCUSSION.—The variations in antler form in this genus and species are numerous, and they will be discussed at length in succeeding paragraphs.

At this point it may be well to consider briefly the relationships of the form under consideration. At once we are confronted with certain conflicting characters, so that the proper classification of the genus and species is somewhat problematical. From the elongated pedicle, it would seem as if *Stephanoceras* might be placed among the Cervulinae, the primitive deer of which the muntjacs are the modern representatives. But then the cervulines are characterized by simple antlers, almost invariably with only two, or at the most three, prongs above the pedicle, whereas the form under discussion has really highly developed antlers with numerous prongs. These well-developed antlers might be brought forward as an argument for placing the genus *Stephanoceras* in the

#### ERRATUM

(American Museum Novitates, No. 854)

After this paper went to press, P. Teilhard de Chardin called my attention to the fact that the name *Stephanoceras* is preoccupied by *Stephanoceras* Waagen, 1869, a cephalopod. Therefore the name *Stephanoceras* as used in the present paper is to be replaced by *Stephanocemas*. στέφανος- a crown; κεμας- a young deer. *Stephanocemas thomsoni* is the generic type.

Edwin H. Colbert



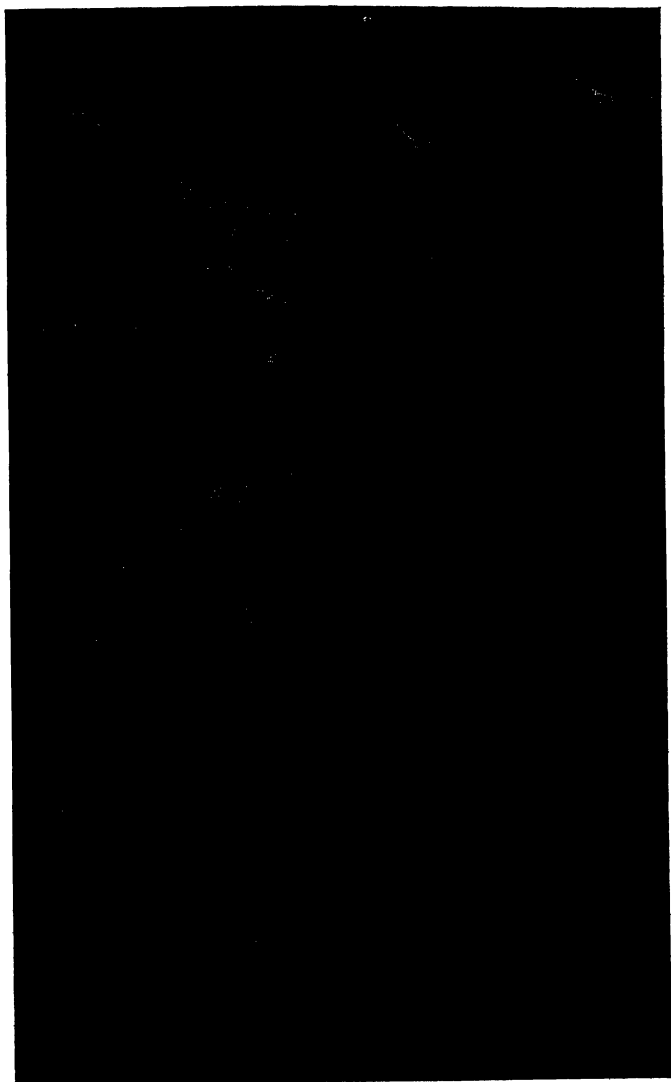


Fig. 1. *Stephanoceras thomsoni*, new genus and species. Type, Amer. Mus. No. 26782, right antler. a.—Dorsal view. b.—Ventral view, showing pedicle scar. c.—Internal lateral view. One-half natural size.

Cervinae. The Cervinae, however, are characterized by very short pedicles. It is true, of course, that some Cervinae, notably the hog deer (*Cervus porcinus*) have rather long pedicles, but even in these forms the pedicles are proportionately shorter than they are in the Cervulinae.

Thus there is evidence for classifying the antlers from Mongolia either with the Cervulinae (on the basis of the long pedicle and the general small size of the animal) or with the Cervinae (on the basis of the rather complicated antler). It would seem probable, that the arguments in favor of *Stephanoceras* being a true cervuline are stronger than those in favor of placing it with the cervines. Therefore the genus is placed in the Cervulinae in this paper. It is regarded as a rather specialized member of the subfamily, in which a complicated antler was precociously developed at a comparatively early date in the phylogenetic history of the group.

#### AGE CHANGES AND INDIVIDUAL VARIATIONS IN THE ANTLERS OF *Stephanoceras*

A great range of antler form in *Stephanoceras thomsoni* is shown by the material in the American Museum collection. Part of this diversity may be attributed to changes due to increasing age in the life of the individual, while factors of individual variation may be invoked to account for such differences as exist in antlers of comparable age and development. Let us first consider the problem of change in antler form due to increasing age in the life of the individual.

By means of a careful selection from the large amount of material at hand, a series, probably representative of changes taking place in the growth from adolescence to old age, has been arranged. At the one end, presumably that of the early life of the animal, the antlers are small and relatively simple, with but few points. At the other end, representative of the advanced age in the animal, the antlers are large and heavy, with but few points. Intermediate between these two extremes, the antlers are of medium size to large size, with many points and a rather complex pattern. Thus it would seem logical to suppose that the young *Stephanoceras* buck had small, simple antlers, with but few points on them. As he advanced in age the antlers became larger and larger, and the points increased in number. Finally, as old age set in, the antlers began to lose points, but they remained large, and it was only with extreme old age that the antlers decreased in size to any appreciable degree. This supposed sequence of age changes is shown by the accompanying illustration (Fig. 5).

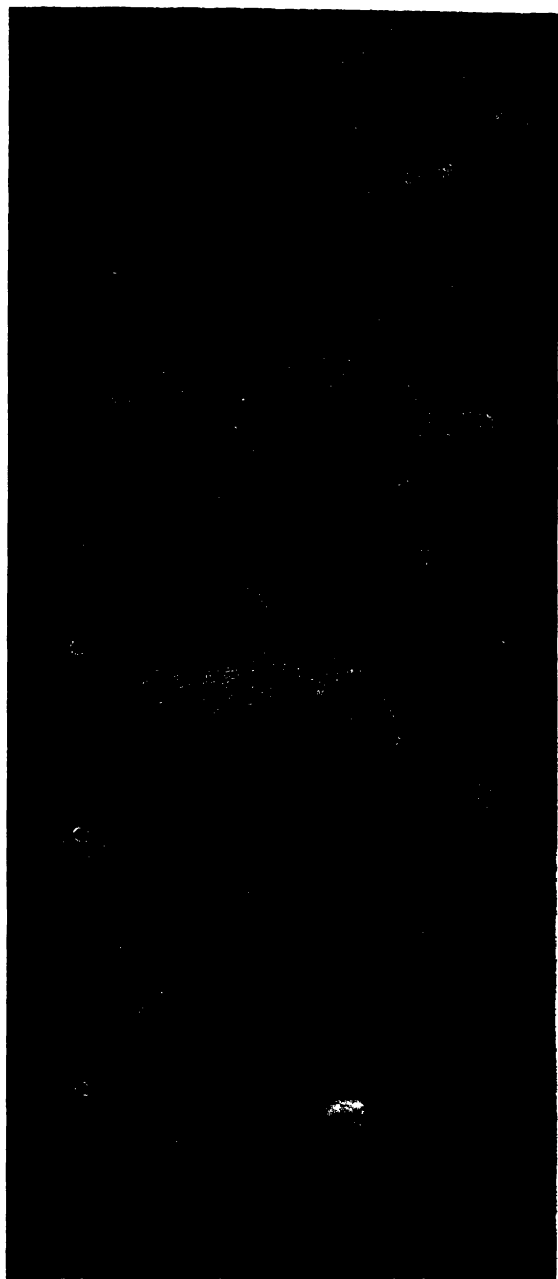


Fig. 2. *Stephanoceros thomsoni*, new genus and species. Amer. Mus. No. 26787, left antler. a.—Ventral view. b.—Dorsal view. Amer. Mus. No. 26779, right antler of a young individual. c.—Dorsal view. Amer. Mus. No. 26786, right antler. d.—Dorsal view. Amer. Mus. No. 26783, left antler. e.—Dorsal view. All figures one-half natural size.

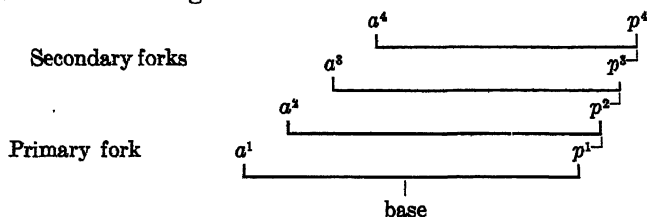
In this illustration the various stages in the growth of the antler are numbered. These numbers are arbitrary. The sequence from I to X is supposed to represent the age changes from adolescence to old age and the stages between IV and VII represent the prime of life period.

An attempt is made here to analyze the antler of *Stephanoceros* on the basis of the probable homologies of its points. This analysis has for its foundation the paper published in 1878 by Victor Brooke on the "Classification of the Cervidae," and the more recent paper, published by R. I. Pocock in 1933 on "Homologies between Branches of the Antlers of the Cervidae." Both Brooke and Pocock proposed systems of nomenclature for the cervid antler, based on their careful and extended studies of numerous genera and species of deer. Both of the nomenclatorial systems advocated by these two authors are essentially similar to each other, but that of Pocock is probably the more logical of the two.

Pocock, as a result of his studies, concluded that the cervid antler attains its ultimate form, no matter how varied that may be in the numerous genera and species, by a process of dichotomous growth. Therefore all of the seemingly different types of deer antlers may be traced back to one simple, common form, and their great diversity may be attributed to various developments of this basic pattern.

According to Pocock, the primitive cervid antler is a simple dichotomously branched structure, consisting of a single anterior prong and a single posterior prong. These two prongs he has designated "*a*" (anterior) and "*p*" (posterior), respectively. Now the complex antlers found in most of the advanced cervidae are formed by further multiple dichotomous branching of the primary prong "*p*." Thus if the *p* prong branches once a relatively simple antler like that of the Sambar deer is formed. As the *p* prong branches more and more, progressively complex antlers are formed. Rarely does the anterior basic prong "*a*" branch, for obviously it is mechanically disadvantageous for this front branch, projecting out over the eye, to be large and cumbersome.

Following this system of nomenclature, the deer antler may be analyzed in the following manner.



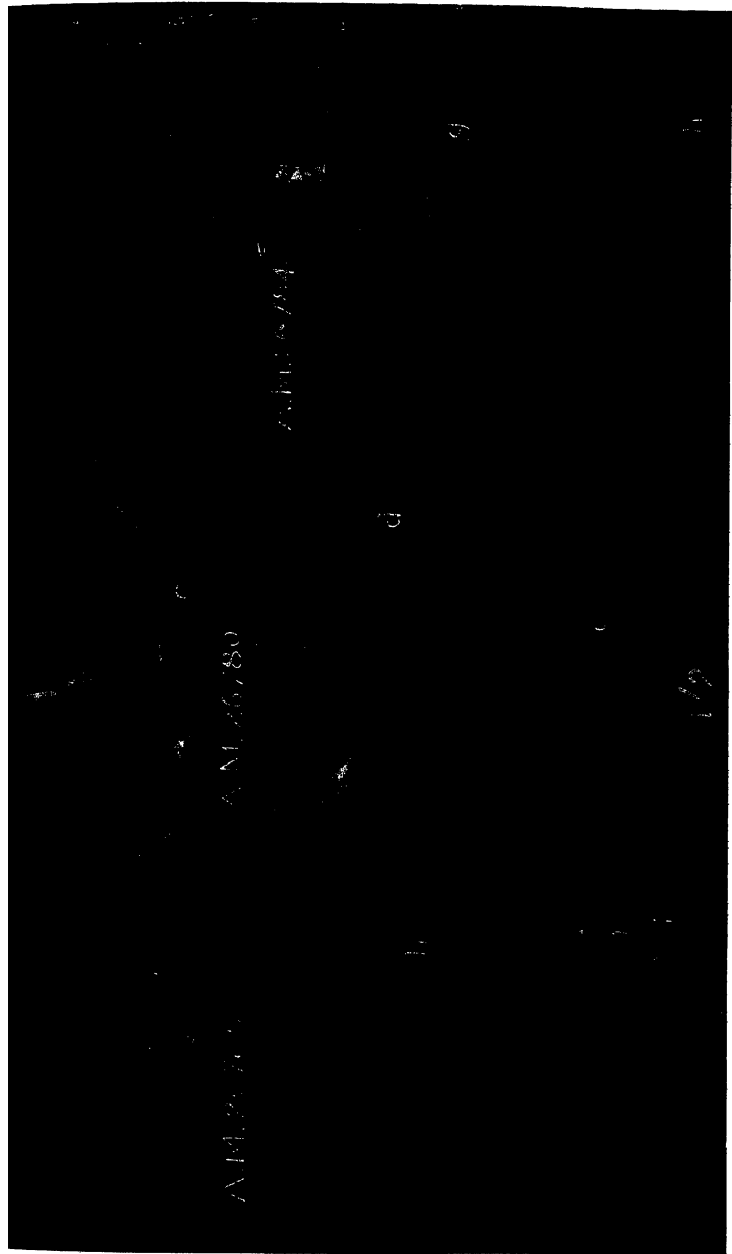
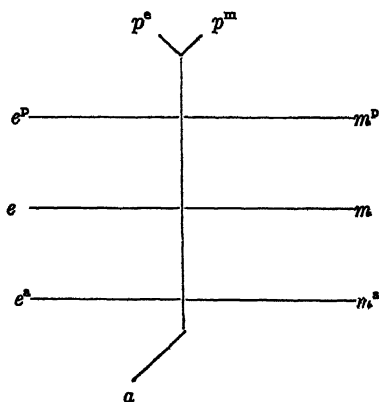


Fig. 3. a-h. *Stephanoceros thomsoni*, new genus and species. Amer. Mus. No. 26785, right antler of an aged individual. a.—Dorsal view. b.—Internal lateral view. Amer. Mus. No. 26780, left antler. c.—Dorsal view. d.—Internal lateral view. e.—Ventral view. Amer. Mus. No. 26784, right antler. f.—Dorsal view. g.—Internal lateral view. h.—Ventral view. 3. i. *Dicrocerus grangeri*, new species. Amer. Mus. No. 26797, antler base. Ventral view. All figures one-half natural size.



This system of nomenclature may be applied with great facility to the usual types of modern and fossil deer antlers, in which the branching is dichotomous through vertical components. But the antler of *Stephanoceras* is peculiar in that it branches in a horizontal rather than in a vertical manner. Consequently Pocock's system of nomenclature is not so easily applicable to these antlers from Mongolia. Of course the above system may be applied to the *Stephanoceras* antler in a general way, by designating the single anterior tine the primary "a" prong and supposing the rest of the antler, that is the palmate portion with its several tines projecting outwardly, inwardly and posteriorly to be homologous with the primary "p" prong. It is convenient, however, to have separate designations for these several tines in the antler of *Stephanoceras*, in order that we may compare different antlers with each other and trace the development of their component parts.

Therefore I propose to call the single anterior tine *a*, supposing it to be homologous with the "a" tine in other Cervidae. The backward projecting broad portion of the *Stephanoceras* antler is designated as *p*, and when this portion of the antler shows two terminal prongs, as it often does, these are designated as *p<sup>e</sup>* and *p<sup>m</sup>*, depending on their external or median positions. The tines projecting laterally from the palmate portion of the antler, although their homologies are with the "p" portion of the normal cervid antler, deserve separate names, so I propose to call those on the external side of the antler *e*, and those on the internal side (or median side) *m*. The individual tines may be indicated by secondary letters, according to whether they are anterior or posterior in position, thus: *e<sup>a</sup>*, *e<sup>p</sup>*, *m<sup>a</sup>*, *m<sup>p</sup>*. With these considerations in mind the *Stepha-*



*noceras* antler may be analyzed in the following manner, as seen in the dorsal or superior view.

The centrally placed lateral prongs, that is the *e* and *m* prongs, are located above the posterior border of the pedicle or pedicle scar. In the accompanying diagram (Fig. 5) the posterior border of the pedicle or pedicle scar is, in each case, placed on the line A-B. Thus a definite datum point, so to speak, is located on each antler, and this facilitates comparisons of antlers of different sizes and shapes with each other.

An examination of the figure just cited will show that throughout the



Fig. 4. *Stephanoceras thomsoni*, new genus and species. Amer. Mus. No. 26790. Antler pedicles. a.—Internal view. b.—Anterior view. c.—Internal view. One-half natural size.

life of the individual *Stephanoceras* the primary portions of the antler continue without fundamentally changing their relations to each other. Thus the portions *a* and *p* continue to remain as constants during the life of the animal. It is by the growth and the subsequent decline of the lateral tines, the various *e* and *m* tines according to the above proposed system of nomenclature, that the changes from adolescence through the prime of life to old age are marked. The very young *Stephanoceras* antler usually has a single *e* tine and a single *m* tine, one on either side. As the animal approaches maturity the *e* and *m* tines increase in number, and the primary *p* prong becomes strongly divided at its apex. As old age approaches the *e* and *m* tines decrease, so that in extreme old age

they may disappear altogether. Stages I to X of the figure give a graphic representation of the changes described above.

#### COMPARISON OF *Stephanoceras* WITH OTHER CERVIDAE

The distinguishing character of the *Stephanoceras* antler is the relationship of the beam, or upper portion, to the pedicle. In most of the deer the beam is more or less of an upward continuation of the pedicle. In those forms having palmate antlers, the palmate portion is an outgrowth, so to speak, of the beam. Thus in the elk or moose (*Alces*), the antler is broadly palmate distally, but there is always a short section of round beam at the proximal junction of the antler with the pedicle.

In *Stephanoceras*, on the other hand, the pedicle joins the antler in the middle of the palmate portion. That is, the palmate antler in this genus is supported on the pedicle just as the cup of a wine glass is supported on its stem. Consequently *Stephanoceras* would seem to differ in this respect from any of the other known genera of Cervulinae or Cervinae. *Cervocerus*, *Procervus*, *Dama* and *Alces* have palmate antlers but in these genera the palmate portion is developed at the distal end of the beam, of which the proximal end is round in cross section.

Undoubtedly this antler form in *Stephanoceras* was developed independently from a less specialized and more primitive antler. We may imagine the evolution of the *Stephanoceras* antler to have followed the course outlined below.

The ultimate ancestral form (in which any antlers were present) probably had a simple forked antler, consisting of an anterior and a

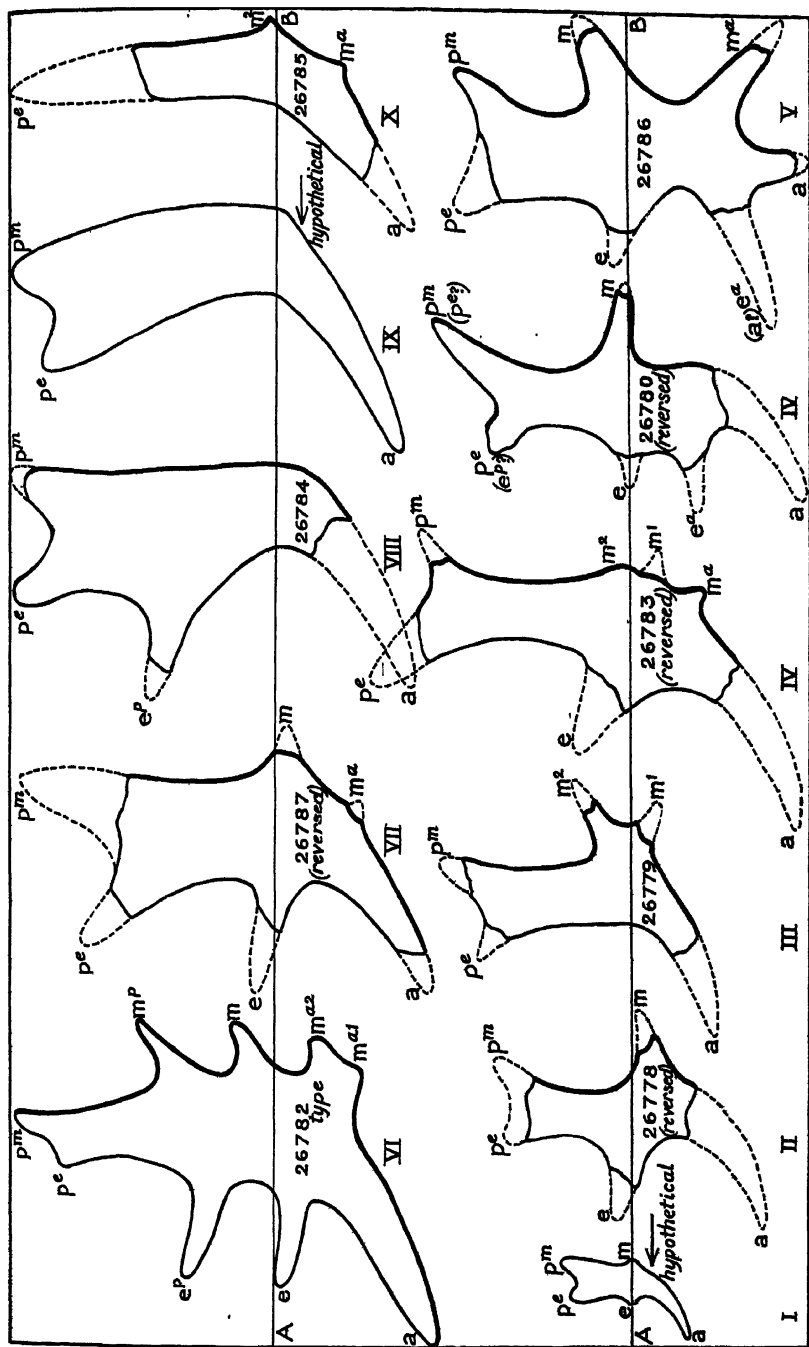
#### Caption for Fig. 5

Fig. 5. Diagram illustrating ten supposed stages in the ontogenetic growth of the antler of *Stephanoceras thomsoni*. Stage I represents the probable form of the first antler in a young individual. Stage X represents a supposed senescent antler from an aged animal. Stages IV to VII show the development of the antler through the prime of life.

The tines of the antler are designated in the following manner.

- a*—anterior tine
- e*—external tines
- e<sup>a</sup>, e<sup>p</sup>*—anterior and posterior external tines
- m*—median or internal tine
- m<sup>a</sup>, m<sup>p</sup>*—anterior and posterior median tines
- m<sup>1</sup>, m<sup>2</sup>*—branches of the median tine
- p<sup>e</sup>, p<sup>m</sup>*—external and median posterior tines

The line A—B is tangential to the posterior edge of the pedicle scar in each case. Diagram to scale, one-half natural size.



**Fig. 5.** (See opposite page.)

posterior prong. The anterior prong remained simple, but the posterior one was broadened transversely so that it became more or less palmate. At the same time it was depressed, as was the anterior prong, so that instead of being vertical, it assumed an horizontal position. Tines projected from the palmate portion. In the course of this evolutionary development the original round beam, which was probably very short, was entirely suppressed, so that finally the pedicle joined the palmate antler without the interposition of a round beam.

## MEASUREMENTS

*Stephanoceras thomsoni*

	Ant.-post. dia. pedicle scar	Trans. dia. pedicle scar	Length, juncture of a tine to tip of p tine	Length of a tine	Greatest width palmate portion
Amer. Mus. No.					
26782—type	24 mm.	16 mm.	131 mm.	80 mm.	38 mm.
26780	28	14	114		31
26783	22	13			35
26784	23	13	132		40
26785	21	15			23
26786	35	13			29
26787	22	14			33
26779	10	18			20

	Length of pedicle	Ant.-post. dia. of pedicle	Trans. dia. of pedicle
26790	50 mm. 42	22 mm. 21	18 mm. 18

*Stephanoceras triacuminatus*,<sup>1</sup> new species

Figures 6 and 7B

TYPE.—Amer. Mus. No. 26775, a left antler and pedicle, with a small portion of the frontal.

PARATYPES.—Amer. Mus. 26776, a right antler without the pedicle. Amer. Mus. No. 26777, two fragmentary antlers.

HORIZON.—From the Tung Gur formation of Upper Miocene age.

LOCALITY.—The type was found at a point about thirty-five miles east of Iren Dabasu on the Kalgan-Urga trail, and about five miles west of Gur Tung Khara Usu,

<sup>1</sup> So named because of the three strong tines or points arising from the central portion of the antler.

Inner Mongolia. The paratypes came from a locality about twenty-five miles north-east of Gur Tung Khara Usu.

DIAGNOSIS.—Antler structurally similar to the antler of *Stephanoceras thomsoni*, but with a restricted palmate portion and with three tines or prongs projecting posteriorly and laterally. Antler supported on a very long pedicle, which joins the antler in the middle of the palmate portion.

DESCRIPTION.—As is the case in *Stephanoceras thomsoni*, the species now under consideration is known only from the antlers.

The antler of *Stephanoceras triacuminatus* is structurally similar to the antler of the generic type; that is, it consists of tines or prongs projecting radially from a palmate central portion, which in turn rests directly on an elongated pedicle. The palmate portion is, however, much smaller than is the homologous portion in *Stephanoceras thomsoni*, and the prongs that project posteriorly and laterally from it are definitely limited to three in number. These three prongs are of subequal length and they are more or less evenly arranged so that they diverge from each other at angles of from forty to fifty degrees. In the type the outer one of these three tines is bifid at its terminus.

The front border of the antler has several small knobs along its edge. In one of the paratypes, No. 26776, there are two of these knobs and they are of rather large size, whereas in another paratype, No. 26777, there are five small knobs.

The pedicle is very long, much longer than is the case in *Stephanoceras thomsoni*. Since there is but one specimen with a pedicle, no definite conclusions may be drawn as to the variability of this structure in the species under consideration. It may be quite possible that some individuals had much shorter pedicles than does the type of the species. The pedicle joins the palmate antler in the center of the palmate portion, without the interposition of a round beam, as is the case in the generic type. Thus the antler rests on the pedicle as the bowl of a goblet rests on its stem, a comparison that was made in connection with the foregoing species. The pedicle was seemingly vertical, or nearly so.

#### A DIAGNOSIS OF THE ANTLER IN *Stephanoceras triacuminatus*

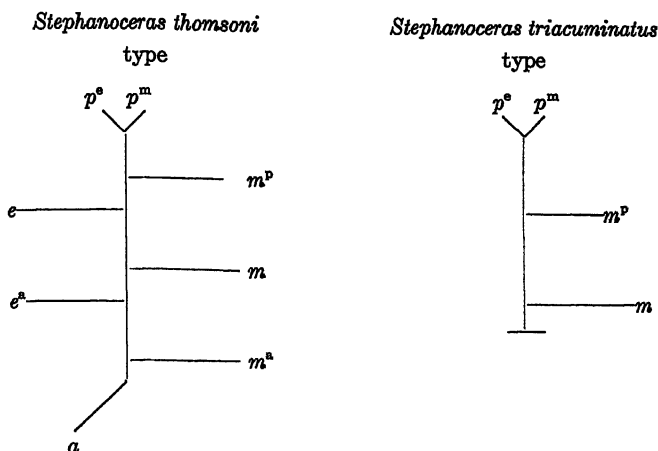
In *Stephanoceras thomsoni* the tines on the antler are variable in number, being few in the young individual, numerous in the adult and less numerous in the aged animal. In *Stephanoceras triacuminatus* the long tines, as differentiated from the anterior knobs, would seem to be limited to three in number. Of these, the external one, which is bifid in the type, would seem to be homologous with the *p* tine of *Stephanoceras*



Fig. 6. *Stephanoceras triacuminatus*, new species. Type, Amer. Mus. No. 26775, left antler and pedicle. a.—Anterior view. b.—External lateral view. c.—Dorsal view. Amer. Mus. No. 26776, right antler. d.—Dorsal view. Amer. Mus. No. 26777, left antler. e.—Dorsal view. All figures one-half natural size.

*thomsoni*. The other two tines are therefore probably homologous with the median tines of the generic type, probably with tines  $m$  and  $m^p$  of the type of *Stephanoceras thomsoni*. The front knobs in *Stephanoceras triacuminatus* may be homologous in part with the  $a$  tine of *Stephanoceras thomsoni*, or they may not have any particular homologies in the generic type.

A comparative analysis of the antlers in the types of the two species of *Stephanoceras* so far described, gives the following results.



#### MEASUREMENTS

##### *Stephanoceras triacuminatus*

Amer. Mus. No. 26775—type	
Length of pedicle	125 mm.
Ant.-post. dia. of pedicle	21
Trans. dia. of pedicle	19
Ant.-post. length of antler	87
Amer. Mus. No. 26776	
Ant.-post. dia. of pedicle scar	22
Trans. dia. of pedicle scar	16
Ant.-post. length of antler	97

##### DICROCERUS LARTET, 1837

GENERIC TYPE.—*Dicrocerus elegans* Lartet.

##### *Dicrocerus grangeri*,<sup>1</sup> new species

Figures 3i and 8

TYPE.—Amer. Mus. No. 26793, a left antler.

PARATYPES.—Amer. Mus. Nos. 26794, a right antler; 26795, base of a left antler;

<sup>1</sup> Named in honor of Dr. Walter Granger of The American Museum of Natural History.



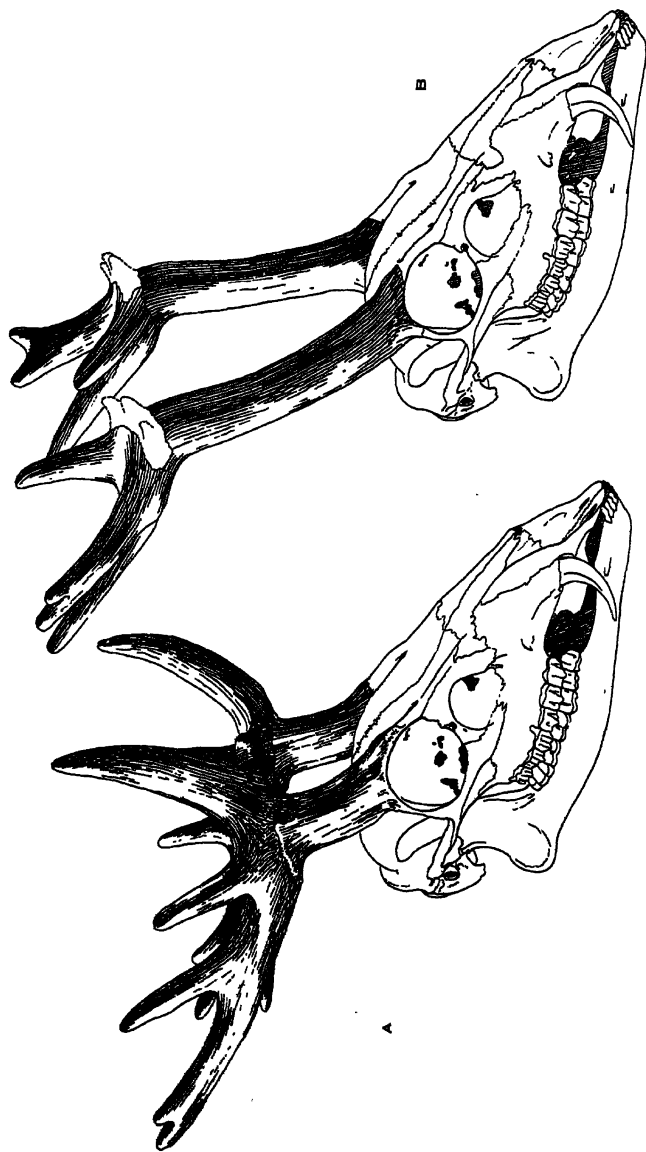


Fig. 7. Perspective views of (A) *Stephanoceros thomsoni* and (B) *Stephanoceros triacuminatus*, to show the position of the antlers on the skull in each of these species. The skulls shown here are drawn from the skull of a recent muntjac. The antlers and pedicles of *Stephanoceros thomsoni* are drawn from Amer. Mus. Nos. 26782, the type antler, and 26790, a pedicle. The antlers and pedicles of *Stephanoceros triacuminatus* are drawn from Amer. Mus. No. 26775, the type antler. The restored portion of this latter antler, shown by dotted lines, is based on a study of Amer. Mus. Nos. 26776 and 26777. Drawn by Louise W. Germann.

26796, base of a left antler with pedicle and portion of frontal; 26797, two antler bases from young individuals; 26798, fragmentary antlers.

HORIZON.—From the Tung Gur formation of Upper Miocene age.

LOCALITY.—A locality about sixty miles east of Iren Dabasu on the Kalgan-Urga trail, and about twenty five miles northeast of Gur Tung Khara Usu, Inner Mongolia.

DIAGNOSIS.—Antler bifurcate and with a broad base. Considerably larger than the typical species of *Dicrocerus*. Prongs of antler very heavy and keeled, diverging from each other at an angle of about fifty degrees in a fore and aft plane. Pedicle of medium length and heavy.

DESCRIPTION.—This species is known from antlers only.

The reference of the antlers, assigned to this new species, to the genus *Dicrocerus* is provisional, because certain differences would seem to separate this species from the typical members of the genus. In *Dicrocerus elegans*, for instance, the two prongs of the antler generally join to form a short but nevertheless recognizable beam, round in cross section. At the base of this beam, where the antler joins the pedicle, there is a well-developed burr, forming a collar between the antler and the pedicle. In some specimens of *Dicrocerus elegans*, however, the beam is not present, and the two prongs, instead of being closely appressed at their juncture, are rather separated from each other.

In *Dicrocerus grangeri* the two prongs of the antler join in a broad, flattened base. As seen from the ventral aspect the antler base of *Dicrocerus grangeri* is similar to the antler base (in the vicinity of the pedicle) of *Stephanoceras thomsoni*. That is, the entire antler base of the species under consideration forms a sort of hemispherical cup, on which, in the middle of the convex side, there is an elliptical depression marking the area of juncture between the pedicle and the antler. The reader is referred to the accompanying illustration (Fig. 8) for a portrayal of the points described in the preceding sentences.

The two prongs of the antler are somewhat separated from each other where they join the base, a contrast to the typical *Dicrocerus* antler, in which an antero-posterior ridge joins the prongs at some distance above the base of the antler.

The two prongs of the antler in *Dicrocerus grangeri* are laterally compressed, or rather the compression is oblique to their antero-posterior dimensions, and this compression has caused the prongs to be keeled on opposite sides. The prongs diverge from each other at an angle of about fifty degrees, although in one specimen No. 26794, the divergence is less, and they are inclined away somewhat from the median line of the skull. The prongs are very long.



Fig. 8. *Dicrocerus grangeri*, new species. Type, Amer. Mus. No. 26793, left antler. a.—Dorsal view. b.—Internal lateral view. Amer. Mus. No. 26794, right antler. c.—Dorsal view. d.—External lateral view. Amer. Mus. No. 26795, base of left antler. e.—Dorsal view. Amer. Mus. No. 26796, base and pedicle of left antler. f.—External lateral view. Amer. Mus. No. 26797, antler. g.—Internal lateral view. All figures one-half natural size.

The pedicle is closely comparable to the pedicle in *Stephanoceras thomsoni*, being of medium length, stout and slightly curved.

The species under discussion is placed in the genus *Dicrocerus* for the sake of convenience, with a full realization that it may prove to belong to some other genus of the Cervulinae. The resemblances between the antler bases of *Dicrocerus grangeri* and *Stephanoceras thomsoni* would seem to indicate that these two forms are closely related to each other.

# MEASUREMENTS

## *Dicrocerus grangeri*

Amer. Mus. No.	Ant.-post. dia. pedicle scar	Trans. dia. pedicle scar	Trans. dia. base of antler
	Length of pedicle	Ant.-post. dia. of pedicle	Trans. dia. of pedicle
26793—type	22 mm.	14 mm.	42 mm.
26794	25	15	40
26795	22	15	56
26796	62	26	23

## *Dicrocerus* sp.

Figures 9 and 10

**SPECIMENS UNDER CONSIDERATION.**—Amer. Mus. Nos. 26799, the basal portion of an antler; 26800, various fragments of antlers.

**HORIZON.**—From the Tung Gur formation of Upper Miocene age.

**LOCALITY.**—These specimens were collected on a small knoll, about sixty miles east of Iren Dabasu on the Kalgan-Urga trail, and about twenty-five miles northeast of Gur Tung Khara Usu, Inner Mongolia.

**DIAGNOSIS.**—Antlers bifurcated with the two simple tines diverging at an angle of about fifty degrees. A well-developed burr is present at the base of the antler, where it joins the pedicle. Pedicle of unknown length, but presumably long. Antler closely comparable to the antlers of *Dicrocerus elegans*.

A number of antlers among the collection of Mongolian fossil Cervidae may be compared directly with the antlers of the well-known European form, *Dicrocerus elegans* Lartet. In size and shape the antlers of these Asiatic specimens bear close resemblances to the antlers of *Dicrocerus*. They are characterized by their simple, bifurcated form, the two tines diverging in a fore and aft plane, and by the well-developed burr at the base of the antler, where it joins the pedicle. A very large specimen, No. 26799, shows the structure of the base of the antler very well. Other specimens, grouped under the number 26800, illustrate

Fig. 9. a. *Dicrocerus* sp. Amer. Mus. No. 26799, base of antler. External lateral view.

b-c. *Dicrocerus elegans* Lartet. Amer. Mus. Nos. 10354 and 9862, antlers. Internal lateral views.

All figures one-half natural size.

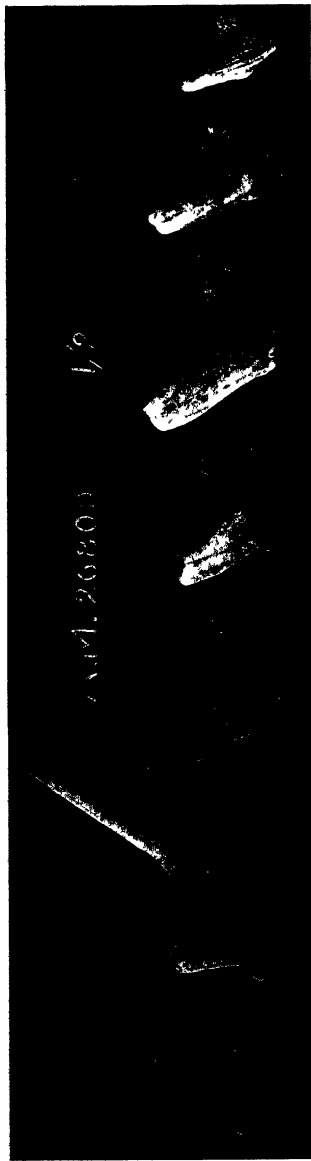


Fig. 10. *Dicrocerus* sp. Amer. Mus. No. 26800. Series of antlers to show increase of size, due to growth. All figures one-half natural size.

various stages in the growth of the antler in the genus under consideration.

It has not been thought advisable to assign a specific name to these few fragmentary antlers of *Dicrocerus*. Figures of some of the specimens listed and described in the foregoing paragraphs are shown in the accompanying illustration.

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# AMERICAN MUSEUM NOVITATES

Number 855

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

June 5, 1936

## SOME AFRICAN ANTHIDIINE BEES

By T. D. A. COCKERELL

The bees recorded in this paper are from the Cockerell-Mackie-Ogilvie Expedition, and the holotypes of the new forms will all be found in the American Museum. The species referred to *Anthidium* do not pertain to the typical section of that genus and will eventually be segregated under different subgeneric or generic names.

The following table will facilitate the separation of the species studied:

- 1.—Females.....2.  
Males.....13.
- 2.—Short broad species, abdomen yellow at sides, and with a broad median black band to apex; scutellum all black.....3.  
Abdomen without such a median black band.....5.
- 3.—Clypeal mark broadly conical in outline, lateral marks small.  
*Pachyanthidium xanthostomum* Cockerell, variety.  
Clypeal mark truncate or broad above.....4.
- 4.—Front tibiae dark on outer side; clypeal mark rounded above; tegulae with no yellow spot.....*Pachyanthidium xanthostomum* Cockerell.  
Front tibiae bright yellow on outer side; tegulae with a yellow spot.  
*Pachyanthidium truncatum livingstonei*, n. subsp.
- 5.—Light abdominal bands widely interrupted in middle except apically.....6.  
Light abdominal bands not interrupted in middle.....7.
- 6.—Sides of mesothorax with a light band; scutellum with light markings; clypeus with a yellowish-white apical band, sending a conical extension upward in middle.....*Dianthidium zebra spilognathum* n. subsp.  
Sides of mesothorax without a light band; clypeus with small light marks; tegulae bright red.....*Dianthidium spilotum* Cockerell.
- 7.—Clypeus not all black, but with a very broad yellow apical band; scutellum with a yellow border.....*Hypanthidium halophilum*, n. sp.  
Clypeus with the tegument all black.....8.
- 8.—Tegulae bright red.....9.  
Tegulae dark with a light yellow spot.....11.
- 9.—Clypeus with the appearance of a narrow pale apical band, but it is due to pubescence; flagellum red beneath; very small, about 5.5 mm. long.  
*Hypanthidium abdominale histrionicum*, n. var.  
Clypeus without the appearance of an apical band.....10.
- 10.—Larger and more robust, with large head; two widely separated marks on top of head; femora mainly black.....*Hypanthidium honestum*, n. sp.  
Smaller, with ordinary head: occipital band entire; femora with more red.  
*Hypanthidium braunsi* (Friese).



- 11.—Tibiae entirely orange on outer side.....*Anthidium lobicaudum*, n. sp.  
 Tibiae at least mainly dark on outer side.....12.
- 12.—Larger and more robust; hind tibiae broadly yellow or red in front.  
*Anthidium poecilodontum* Mavromoustakis.  
 Smaller and less robust; hind tibiae yellow only at base.  
*Hypanthidium capicola* (Brauns).
- 13.—Abdomen with pairs of widely separated spots; small short species with red legs and hairy eyes.....14.  
 Abdomen not so marked.....15.
- 14.—No spots on second tergite, and no yellow marks on scutellum.  
*Pachyanthidium occipitale* Cockerell.  
 Spots on second tergite, and light marks on scutellum.  
*Pachyanthidium carinaticeps*, n. sp.
- 15.—First tergite with a very large yellow or orange spot on each side.....16.  
 First tergite not so marked.....20.
- 16.—Scape marked with yellow.....17.  
 Scape all black.....18.
- 17.—Small; face all yellow below antennae; eyes green; tibiae yellow on outer side.  
*Hypanthidium sakaniense*, n. sp.  
 Large and robust; supraclypeal area yellow only on lower margin.  
*Pachyanthidium severini maculiferum*, n. subsp.
- 18.—Larger and more robust; abdomen partly red.  
*Pachyanthidium severini abjunctum*, n. subsp.  
 Smaller; abdomen without red.....19.
- 19.—Axillae with a large yellow spot..*Pachyanthidium xanthostomum* Cockerell.  
 Axillae black.....*Pachyanthidium truncatum livingstonei*, n. subsp.
- 20.—Abdominal bands interrupted in middle; cream-colored marks at extreme sides of first tergite.....*Anthidium hispidulum*, n. sp.  
 Abdominal bands narrow, not interrupted in middle.....21.
- 21.—Clypeus all yellow.....22.  
 Clypeus black, or not all yellow.....23.
- 22.—Smaller; tibiae orange on outer side.....*Anthidium lobicaudum*, n. sp.  
 Larger; tibiae black on outer side....*Anthidium capense acaciae*, n. subsp.
- 23.—Clypeus with a pale yellow arched apical band.  
*Anthidium pallidicinctum multicinctum*, n. subsp.  
 Clypeus with a large triangular pale mark...*Anthidium pallidicinctum* Friese.  
 Clypeus all black; mandibles mainly yellow..*Hypanthidium capicola* (Brauns).

### ***Anthidium capense acaciae*, new subspecies**

MALE.—Clypeus cream-color, no lateral marks; mandibles pale with three teeth, the large apical one partly red and partly black, the others black; the very long and abundant hair of head and thorax all white, very slightly creamy dorsally; anterior tibiae with a broad brownish-yellow stripe in front; the tarsi are not all light, the middle and hind ones being largely blackened, especially posteriorly; no pulvilli; second recurrent nervure meeting outer intercubitus; thorax without light markings; band of first tergite very narrow and obscure; tergites 2 to 5 with entire ivory-white bands; sixth with a dull yellow band, contracted in middle; apex quadridentate, dull yellow.

Orange Free State: Gum Tree, February 29, 1932 (J. Ogilvie). This may be a race or only a variety, but it is easily known by the white hair of thorax above. So far as I can make out, *A. quadridens* Brauns is another subspecies of *A. capense*, having the red hair above, and the abdominal bands yellow. All the members of this group have the second recurrent nervure meeting outer intercubitus.

***Anthidium hispidulum*, new species**

MALE.—Length about 7 mm., anterior wing 6; robust, black, head and thorax with long white hair, fulvescent on vertex, contrasting with the pure white of occiput; face narrow, the orbits converging below; mandibles light yellow, with three large black teeth; clypeus and lateral marks very pale yellow (supraclypeal area all black), the clypeus longer than broad, the sides nearly vertical; lateral marks filling space between clypeus and eye, and extending upward as broad bands, abruptly truncate at about level of antennae; vertex shining, with strong punctures; no light marks at top of head; scape with a pale yellowish stripe at upper end; flagellum long, black, second antennal joint about as long as third, the next three appreciably longer than third, and about equal; thorax wholly without light markings; mesothorax dull, with only a little space posteriorly shining; scutellum rounded, with a projecting very obtuse edge, the disc shining, with well-separated punctures; tegulae large, black, the front margin pallid; wings strongly dusky; second recurrent nervure meeting outer intercubitus; legs mainly black, with long white hair, forming long fringes on front and middle tibiae and tarsi; anterior femora and tibiae light red in front; middle and hind tibiae with a creamy-white spot at apex in front, that on hind tibiae large; front tarsi very pale reddish, the others darker, the hind basitarsi largely blackened, and with dense white hair, but the last joints of hind tarsi bright red; abdomen broad, glistening, with creamy-white marks; first tergite all black except a large pyriform mark at each extreme side; second similarly marked, except that the spots are elongated; tergites 3 to 6 with bands which are broadly and equally interrupted in middle, that on third excavated and slightly interrupted sublaterally, on fourth crossed sublaterally by an oblique black line; seventh tergite entirely black, rugose, with a shallow median emargination.

Natal: Greytown, October 20, 1931 (J. Ogilvie). Resembles *A. kimberleyanum* Friese, but differs by the broad lateral marks of face and much larger marks on tergites 3 to 6, as well as other characters. The two species are, however, known from opposite sexes, and it might seem possible that the differences were all sexual. Considering everything, with the very different localities, I do not think this is the case.

***Anthidium lobicaudum*, new species**

MALE (type).—Length about 7 mm., anterior wing 6; rather robust, black, with light yellow markings; hair of head and thorax entirely white; mandibles yellow with the teeth black; not counting inner corner, there are two strong sharp teeth, and a rudimentary one between them; clypeus finely punctured, hardly at all shining, pale dull orange, the sides sloping, so that the clypeus is very broad at lower end, the

margin simple; lateral marks filling space between eye and clypeus, and extending upward to about lower level of antennae, where broadly squarely truncate, so that they make a right angle with the orbit; supraclypeal area black; scape black; flagellum shining, obscurely brown beneath; a small transverse yellow mark at each side of top of head; mesothorax and scutellum shining between punctures; spot on tubercles, very broadly interrupted band on mesothorax in front, broad outer margin of axillae, and margin of scutellum narrowly interrupted in middle, all cream-color; scutellum rounded, ordinary; tegulae large, black, with a cream-colored band in front; wings strongly brownish; second cubital cell very long, the second recurrent nervure going a short distance beyond its end; knees red; front and middle femora black above, pale yellow below; hind femora black with a yellow mark at base; tibiae bright orange; basitarsi pale yellow, small joints red; no pulvilli; abdomen shining, well punctured, with cream-colored markings; first tergite with a large mark at each side, and a very slender band across the middle; second with a narrow band, broadened laterally; third with a rather broad entire even band; fourth and fifth with very broad bands, margin of fifth red; sixth pale red with a broad paler band, not conspicuous; no lateral spines; seventh pale red, with a pair of broad rounded lobes, about or nearly as far apart as the width of one.

**FEMALE.**—Size and general appearance the same; mandibles with four teeth, the innermost minute; face black, the dull clypeus with the lower margin obscurely reddish; yellow marks present on top of head; thoracic marks as in male; legs marked nearly as in male, but hind basitarsi broad and dark brown; first tergite with the narrow band very slenderly united with the lateral spots; tergites 2 to 4 with narrow entire bands; apex red; ventral scopa shining white.

Belgian Congo (Katanga): Bianco, August 8-11, male taken by A. Mackie, female by J. Ogilvie. The end of the abdomen recalls that of *A. lobiferum* Cockerell which has a red abdomen with pale yellow bands. There is perhaps some affinity with *A. enslini* Alfken, which lives in Egypt.

#### ***Anthidium pallidicinctum* Friese**

Natal: Greytown, October 20, 1931, males (A. Mackie, J. Ogilvie). The type locality is Pretoria. This may not be separable, as a species, from *A. integrum* Friese, but that name is preoccupied (*A. integrum* Eversmann, 1852).

#### ***Anthidium pallidicinctum multicinctum*, new subspecies**

**MALE.**—Length about 7 mm., anterior wing about 6.5 mm.; robust, with broad abdomen; black, with white hair, abundant on face and sides of thorax; eyes pale reddish brown; mandibles yellow, with two strong teeth, which are black with a red base; clypeus strongly punctured, but elevated and shining in middle (roof-like), black, except a very broad, curved, pale yellowish apical band; a narrow pale yellow stripe along inner orbits, to above level of antennae; vertex densely punctured, hardly shining; antennae black, the flagellum faintly reddish beneath; no light spots at top of head; thorax all black, except that the scutellum has a widely interrupted slender band on the projecting keel, which is shallowly emarginate in middle, and

rounded at sides; mesothorax and scutellum shining on disc, but closely punctured; area of metathorax dull above, but highly polished below the transverse ridge; tegulae black, with a pellucid white anterior margin; wings brownish hyaline; second recurrent nervure meeting outer intercubitus, first near base of second cubital cell; femora black, with a light spot on knees; front tibiae very short and thick, at apex reddish in front, and with a yellow mark behind; middle tibiae black, with a light dot at apex; hind tibiae with a pale yellow stripe, confluent apically with a round spot; front tarsi pale red; mid-tarsi darker, the very long basitarsi pale yellow in front; hind tarsi black, the last joint light red, and the basitarsi with a large yellow patch; front and middle tibiae and tarsi with long fringes of pure white hair; abdomen broad, black, tergites 1 to 7 with pale yellow bands, that on first broken in middle; none with any sublateral emargination; seventh tergite transverse, unarmed, the margin minutely crenulate (resembling the sixth tergite of *A. reticulatum* Morawitz and *A. mocsaryi* Friese); venter black; when the yellow band of seventh tergite is seen from beneath, it appears obtusely angulate and very narrowly interrupted in middle. There are no pulvilli on the feet.

Transvaal: Louis Trichardt, alt. 3112 ft., April 4-10, 1932 (J. Ogilvie). In Friese's table this runs near *A. capicola* Brauns, which has the end of the abdomen quite different. It is actually very close to *A. pallidicinctum* Friese (*pallidicindum*, in Friese's paper, is doubtless a misprint), which has a large triangular mark on clypeus, but agrees in structure. I conclude that it is best regarded as a subspecies, but it seems possible that the sexes described by Friese do not belong together, in which case the female, first described, must be taken as the type. The matter is further complicated, as shown in Ann. Mag. Nat. History, June, 1932, p. 519. I concluded that *A. pallidicinctum*, as represented by the female, was a synonym of *A. albolineatum* Cockerell, but if that is correct, I do not think the male can possibly belong with it. I also thought that *A. integrum* Friese (based on a male from Willowmore), which has been held to be the prior name for *A. pallidicinctum*, was distinct. The male *A. integrum* is said to have tridentate mandibles, whereas those of *A. pallidicinctum* from Greytown are bidentate, as are those of *multicinctum*. The matter, therefore, remains uncertain until the types are reexamined, and the sexes are definitely associated. Brauns (1912) gave an account of both sexes of *A. integrum*, stating that the abdominal bands were ivory-white in the female, yellow in the male. The name *A. integrum* is preoccupied, so that if the two Friesean species are the same, *A. pallidicinctum* stands, unless (as I supposed from comparison of the females) it falls before *A. albolineatum*.

***Anthidium poecilodontum* Mavromoustakis**

Cape Province: Van Rhyns Pass, November 21 (Cockerell). One

female. The second recurrent nervure in this species does not reach the end of the second cubital cell.

***Dianthidium spilotum* Cockerell**

Natal: Greytown, October 20, 1931 (J. Ogilvie). A female, differing from a cotype by the better developed light markings on abdomen, the apical patch being very large. The clypeus has a small pale mark at each side above the apical corner. The type locality of the species is Kark-loop, Natal. This is nine miles from Howick, which is about thirty-five miles from Greytown.

***Dianthidium zebra spilognathum*, new subspecies**

FEMALE.—Length 7 mm., anterior wing 5; nearly agreeing with *Anthidium zebra* Friese, but differing from a Willowmore *A. zebra* thus: clypeal mark with the median (upward) extension less slender, and the lateral ones more developed; lateral marks large and triangular, filling space between clypeus and eye, abruptly truncate at lower level of antennal sockets; in reality the inner part of the mark represents an extension, comparable to the dog-ear marks of *Perdia*; wings very dark; femora more blackened (in both the hind tibiae are black, with a pale mark at base, and the broad hind basitarsi on outer side are creamy white, with the end black); sixth tergite with the large pale patch entire, not divided by a black band in middle. The ventral scopa does not differ. The feet have pulvilli, and the second recurrent nervure goes beyond the end of second cubital cell. The sides of mesothorax, the axillae and scutellum are marked with yellow. The mandibles are dark, with a small light spot.

Natal: Greytown, October 20, 1931 (L. Ogilvie). Somewhat related to *D. spilotum* Cockerell, but the markings are quite different. The *Anthidium zebra* Friese must be called *Dianthidium zebra*.

***Hypanthidium abdominale* (Friese) variety *histrionicum*, new variety**

This is a very small specimen, about 5.5 mm. long; clypeus black with the appearance of a pale yellowish margin, but this due to hair; mandibles red clouded with yellowish, the teeth black; flagellum bright red beneath; occiput with a continuous yellow band, extending some distance down cheeks; tegulae very bright red, with a pale yellow spot in front; tubercles with a small pale spot; mesothorax and scutellum shining, with well-separated punctures; mesothorax all black, but axillae with a yellowish-white mark, suffused with red around the margins, and scutellum with a broad but widely interrupted yellowish-white band; wings only slightly dusky; first recurrent nervure as far from base of second cubital cell as second is beyond apex; femora black, with pale reddish knees, the anterior femora pale red in front; tibiae all clear red, with a pale yellow knee-spot; front and middle tarsi red; hind tarsi shining black, with bright red hair on inner side; abdomen black with slender yellowish white bands, but margins of tergites reddish, and sixth tergite broadly reddened basally; band on first tergite enlarged at sides, otherwise slender and suffused with red, but entire; bands on tergites 2 to 5 greatly narrowed sublaterally; ventral scopa bright orange, shining white at sides. The hair of head and thorax is white.

Cape Province: Blaukrans, near Calvinia, November 17, 1931, one female (L. Ogilvie).

It will be observed that this is not the female Friese described for his *H. abdominale*, his insect being apparently *H. oraniense* (Brauns). Brauns in 1912 gave a table of this group, and the present insect goes fairly well to *H. abdominale* as there interpreted. In the British Museum I saw both sexes of *H. abdominale* and noted that the ground-color of the abdomen was red in the male, black in the female. The supposed female *H. abdominale* of Friese was named *nigritarse* Friese in 1904, and this has priority over Brauns' *oraniense*, supposing it to be the same insect. As the Blaukrans bee is not typical *H. abdominale*, I provisionally give it a varietal name, not knowing whether it represents individual variation or a distinct species.

#### ***Hypanthidium halophilum*, new species**

FEMALE.—Length about 8 mm.; robust, black, with white hair on face, cheeks and sides of thorax, but rather dark ferruginous on head and thorax above; face broad, but eyes converging below; the following yellow markings are all changed to bright red by cyanide in the type, more than lower half of clypeus, mandibles except the five black teeth (the two innermost minute), knees, outer sides of all the tibiae (front and middle tibiae with a black patch posteriorly near base, hind tibiae entirely black behind), mark at sides of axillae, uninterrupted margin of scutellum, narrow entire bands on tergites 1 to 5, and two large marks, slightly united in middle, on sixth tergite; scape long; flagellum short, dusky red beneath; no light spots on head above or on mesothorax; scutellum rounded, ordinary; tubercles with a small yellow spot; tegulae black on disc, yellow in front and behind; wings brownish, second recurrent nervure going beyond end of second cubital cell; femora mainly black, but anterior ones red in front, and hind ones with a red (or yellow) mark on apical part; tarsi yellow, the hind basitarsi blackened apically and posteriorly, and the small joints blackened behind; front and middle tarsi with dense snow-white hair at base; no pulvilli; abdomen very densely punctured; sides of tergites prolonged into sharp pellucid spines; ventral scopa shining white.

Cape Province: Sea Point, Cape Town, November 1931–January 1932 (J. Ogilvie). At first sight, it looks like *H. capense* (Cameron), but it is easily distinguished by the partly yellow clypeus, yellow mandibles, and yellow border of scutellum.

#### ***Hypanthidium honestum*, new species**

FEMALE.—Length about 8 mm., anterior wing 6; very robust, with very large head, the diameter of which is nearly 4 mm.; hair of head and thorax white, abundant on face and pleura; face very broad, entirely black; mandibles very broad, red, with four black teeth; clypeus entirely dull and very densely punctured; lower margin of supraclypeal area broadly emarginate, highly polished; vertex shining, with strong punctures; at each side of top of head is a large reddish-orange mark, tapering to a point at each end; antennae black, the short flagellum obscurely brownish beneath, the scape strongly punctured; mesothorax and scutellum very strongly punctured on a polished surface; median sulcus of mesothorax strong; the only light

marks on thorax are the reddish-orange spots on axillae, and interrupted band on scutellum; area of metathorax dull and minutely punctured above, polished below the transverse ridge; tegulae large, light ferruginous (not at all dark at base), with an orange band in front; wings reddish; first recurrent nervure more distant from base of second cubital cell than second is beyond the cell; femora black, marked with red apically in front; tibiae and tarsi bright red, the tarsi infuscated apically, and this involves all the small joints of hind tarsi, but not the basitarsi; no pulvilli; abdomen broad, shining black, with well-separated punctures; sides fringed with white hair, but ventral scopa dark brown; no lateral denticles; tergites 1 to 5 with entire reddish-orange bands, successively broader, but on first expanded at each extreme side (sixth tergite missing in type); first sternite reddened apically.

Cape Province: Calvinia, November 16, 1931 (Alice Mackie). Looks at first like an overgrown *H. braunsi*, but that has a white ventral scopa, entire occipital band, and other differential characters. It is allied by the dark scopa to *H. matjesfonteinense* (Mavromoustakis), but it differs from that by the bright red tegulae, clear red hind basitarsi, etc.

#### ***Hypanthidium sakanienae*, new species**

MALE.—Length about 7 mm.; of the usual *Hypanthidium* form, agreeing also in the scutellum, the second recurrent nervure going far beyond end of second cubital cell, and the feet without pulvilli; eyes pale green; mandibles bidentate, pale yellow with the teeth black; face entirely pale yellow below antennae; lateral marks ending above at about level of antennae, but descending toward orbit; the yellow extends upward, filling the space between antennae, just above antennae the sides of the figure converge to form a right angle; face and front with pure white hair; clypeus broad above, and much expanded at sides, the margin concave; a broadly interrupted yellow stripe on top of head; fourth antennal joint enlarged and red beneath, the flagellum otherwise black; mesothorax and scutellum coarsely punctured, shining between punctures; mesothorax with a pair of pale yellow bands on front margin, the distance between them greater than the length of either; a yellow spot on tubercles; axillae and the rounded scutellum broadly bordered with pale yellow, the band on scutellum interrupted; hair of thorax white; tegulae large, dark brown, with a large yellowish-white spot on outer side; wings dusky, especially in the apical region; second cubital cell very long, the first recurrent nervure ending as far from its base as second beyond its apex: basal nervure going far basad of nervulus; legs yellow, with the knees reddish, and a red spot at end of each tibia; the femora are dark above; abdomen broad, shining, well punctured, the apex with a pair of short broad obtuse lobes, the sixth tergite convex laterally, the apical angles dentiform but short; first tergite with a large yellow mark on each side; second with a band, the lateral portions of which are broad, abruptly narrowed to the almost linear median portion, which is interrupted in middle; third tergite with a broad yellow band, somewhat narrowed in middle, the extreme base black; remaining tergites yellow, with thin pale brown margins; venter with much pure white hair.

Belgian Congo (Katanga): Sakania, September 21, 1931 (J. Ogilvie).

In my table of Belgian Congo species it runs out entirely, with no close relative. In Friese's table it goes nearest to the South African *Anthidium integrum* Friese, but that does not have the bilobed apex, and the markings are different. The caudal end is suggestive of *Anthidium nitidicolle* Friese.

***Pachyanthidium* (*Trichanthidium*) *carinaticeps*, new species**

MALE.—Length about 5.9 mm., anterior wing 6; very short and broad, with long wings, the anterior wings dark brown, with a hyaline band down the middle, reaching a little beyond the cells; mandibles pale orange, black at tip; clypeus cream-colored, highly polished, little broadened below; hair of face white, but of top of head light red; scape bright red, flagellum obscurely reddish beneath; elevated occipital keel red, basally with a pale band; tubercles and tegulae red; axillae with outer half red; scutellum with a pair of transversely elongate large triangular pale yellow marks almost touching in middle line, and the broad margin hyaline; legs red, the femora mainly black, but red apically; tergites with rufous hind margins; first tergite shining, with well-separated punctures, and a light yellow spot at each extreme side; second to fifth with successively smaller sublateral spots, the second also with lateral spots, but the others only reddened at extreme sides; structure of abdomen as in *P. cucullatum* Friese, the three slender apical teeth red. Eyes hairy. The feet have distinct though small pulvilli.

Cape Province: Mitchell's Pass, Ceres, February 1932 (Alice Mackie). Very close to *P. cucullatum* (Friese), but known by the large yellow marks on scutellum; and the paler, less broadened clypeus, in which respect it approaches *P. occipitale* Cockerell, but the mesothorax is shining, with well-separated strong punctures, while in *P. occipitale* it is dull and more densely punctured.

***Pachyanthidium* (*Trichanthidium*) *occipitale* Cockerell**

Southern Rhodesia: Matopo Hills, April 1932 (J. Ogilvie). One male, which I refer to *P. occipitale* rather than to *P. cucullatum* (Friese), because the clypeal yellow patch is highly polished and weakly punctured, and not expanded below. (In *P. cucullatum* it is more strongly punctured, and broadened below.) The second tergite is without sublateral spots, which are well-developed in a *P. occidentale* from Elisabethville.

***Pachyanthidium severini* (Vachal)**

This species was described from a male collected by Duvivier at Moliro, French Congo. It proves to be widely spread over Africa, but runs into a number of local races or subspecies, which may be separated thus:

- 1.—Scape marked with yellow in front, either a continuous stripe or two spots; lateral margins of mesothorax entirely black; axillae and margin of scutellum with pale stripes, those on scutellum sometimes feebly developed; first two



- tergites black with large yellow marks at sides, third black at base (Beit Bridge, Southern Rhodesia, April 12, 1932, four males, variable in size, collected by Alice Mackie and J. Ogilvie).....*P. severini maculiferum*, n. subsp.
- Scape not marked with yellow in front.....2.
- 2.—Scutellum and axillae entirely black; first two tergites broadly black in middle, red and yellow at sides, third with the part before the depression black in middle; sides of mesothorax black....*P. severini melanaspis* (Cockerell, 1935).
- Scutellum and axillae with light markings.....3.
- 3.—First tergite black in middle, and second partly black; mesothorax without a lateral yellow band.....*P. severini severini* (Vachal).
- Black area of abdomen reaching third tergite; mesothorax laterally with a yellow band.....*P. severini daressalamicum* (Strand).

A male from Bianco, Belgian Congo, August 8–11 (J. Ogilvie), has the abdomen and entirely black mesothorax as in *P. severini maculiferum*, but the scape is entirely black; the supraclypeal area has only a barely visible yellow speck at each lower corner; the lateral face-marks take the form of very broad bands, contiguous with clypeus, but only touching the orbit at lower end, the upper end obliquely truncate with the outer corner highest; the spot on axillae is practically obsolete. The mandibles are yellow except the teeth and lower margin. Compared with the type of *P. severini melanaspis* Cockerell, from Uvira, this is somewhat smaller, the yellow marks on top of head are much smaller, the face-marks are different, the punctures of the entirely dull mesothorax are much finer and closer, and the scutellum is shorter and more finely punctured. The sculpture of mesothorax and scutellum similarly separate it at once from *P. severini daressalamicum*, at least as represented by a specimen from Umtali, Southern Rhodesia. On comparing the type of *P. severini maculiferum*, I find the mesothorax and scutellum to be of the same type as in the Bianco specimen, but there is some difference in the first tergite, which in *maculiferum* is very finely and closely punctured to the apex, whereas in the Bianco insect the part beyond the slight dorsal transverse ridge is shining, its basal portion with punctures running in well-separated lines, its apical part with minute punctures, not nearly so dense as in *maculiferum*.

It seems evident that the Bianco specimen must stand as another subspecies, which may be called: *Pachyanthidium severini abjunctum*, new subspecies.

***Pachyanthidium truncatum livingstonei*, new subspecies**

**FEMALE.**—Like *P. truncatum alberti* Cockerell, with broad black band at end of abdomen, but clypeus entirely lemon yellow the upper margin of the yellow, therefore, very broadly truncate, not obtusely conical as in *P. truncatum alberti*, and only a black line (instead of a cuneiform space) between clypeal yellow and upper part of

lateral marks, which are broadly obliquely truncate, some distance above level of clypeus. The yellow occipital band is continuous (though very slender in middle), and the axillae have a very slender yellow line along outer margin. In *P. truncatum alberti* the occipital band is very broadly interrupted, and the axillae are all black.

Tanganyika Territory: Ujiji, August 1931 (J. Ogilvie). At Dilolo in Katanga (Cockerell, J. Ogilvie) occurs a form which may be considered a variety of *P. truncatum livingstonei*, transitional toward *P. truncatum alberti*. The upper edge of clypeal yellow is very broad, but distinctly rounded instead of abruptly truncate, the occipital band is interrupted, the axillae have a very minute yellow dot in one specimen, none in the other. It is apparently another local race, but I have not thought it worth while to give another name. The ventral scopa is white in all these insects; the Katanga ones have collected pale pink pollen. The name given recalls the meeting of Livingstone and Stanley at Ujiji. The spot is now marked by a monument.

I have been much perplexed concerning the male of this insect. I have three specimens, two from Elisabethville, September 11-17, 1931 (W. P. Cockerell), and one from Greytown, Natal, October 20 (L. Ogilvie), which I place here; they are, however, the species described by Friese (1924) as the male of *P. compactum* (Smith). I have from Durban, Natal (C. N. Barker), what I consider to be male *P. compactum*. It has the very short broad scutellum, and has yellow marks at sides of occiput, and sixth tergite with the lateral thirds yellow. I believe it to be correctly named. The supposed male *P. truncatum livingstonei* is very closely allied, but certainly different. There are no light marks on occiput; the first two tergites have large yellow marks, pointed mesad, at sides; the third has a very narrowly interrupted yellow band; the following tergites are rich yellow right across. The apex has a pair of widely separated denticles, and the margin is swollen on each side; essentially the same structure as figured by Mavromoustakis (1934) for *Anthidium junodi* Friese. The true female of *P. compactum*, as described by Smith, has the sixth tergite all black. Hence it would appear that the male of *P. compactum*, as recognized by me, is more like *P. truncatum livingstonei* than is the male assigned to that insect. This seems anomalous, and while I believe my interpretation will stand, it may be confirmed or refuted by later researches.

***Pachyanthidium xanthostomum* Cockerell**

Belgian Congo (Katanga): Kafubu Mission, September 1931, two females (J. Ogilvie, L. Ogilvie).

Southern Rhodesia: Umtali, May 1932 (J. Ogilvie); a male from Vumba, female from Christmas Pass. The male has a large yellow spot on axillae, and a minute one at extreme sides of scutellum; there is a small yellow mark on the lower margin of the supraclypeal area. The abdominal markings are orange in the female, lemon yellow in the male.

# AMERICAN MUSEUM NOVITATES

Number 856

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

June 5, 1936

## AFRICAN BEES OF THE GENUS *COLLETES*

By T. D. A. COCKERELL

The bees now recorded are the hitherto unreported specimens from the Cockerell-Mackie-Ogilvie Expedition of 1931-1932, and some material received from Dr. J. Bequaert. The holotypes described will be found in the American Museum.

It is a singular fact that, whereas the *Hylaeus* of Central and South Africa constitute a peculiar group, different from those of other regions, the *Colletes* are in the strictest sense congeneric with those of the Holarctic Region, though the species are different.

The species now recorded may be separated as follows:

- 1.—Females.....2.  
Males.....11.
- 2.—Hair of scutellum not evidently red.....3.  
Hair of scutellum red.....6.
- 3.—Larger (about 12 mm. long); mesothorax and scutellum with much black hair.  
*antecessus* Cockerell.  
Smaller.....4.
- 4.—Scutellum covered with erect black hair.....*sororcula*, n. sp.  
Scutellum without such hair; clypeus dull.....5.
- 5.—Larger; face very broad, mandibles dark.....*malleatus* Cockerell.  
Smaller; orbits strongly converging below, mandibles red.  
*fuscototus* Cockerell.
- 6.—Thorax above without black hair.....7.  
Thorax above with some black or dark hair.....9.
- 7.—Clypeus with well-separated elongate punctures; mandibles red, black at base.....*michaelis*, n. sp.  
Clypeus very densely punctured.....8.
- 8.—Second tergite shining, with fine punctures and lineolate sculpture.  
*marleyi* Cockerell.  
Second tergite dull, with excessively minute punctures, barely visible under a lens.....*callaspis*, n. sp.
- 9.—Scutellum without dark hair mixed with the red; abdominal bands white or grayish white (not at all ochreous); face narrower than in *C. marleyi*, with orbits more converging below.....*ogilvies*, n. sp.  
Scutellum with dark hair mixed with the red: abdominal bands ochreous.....10.
- 10.—Larger; first tergite highly polished.....*sordescens* Cockerell.  
Smaller; first tergite dull.....*ruwenzoricus*, n. sp.
- 11.—Thorax with much black or dark hair above.....12.

- Thorax without dark hair above.....13.
- 12.—Clypeus polished, sparsely punctured, with a deep median groove.  
*mackieae* Cockerell.  
 Clypeus closely punctured.....*bukavanus*, n. sp.
- 13.—Mesothorax and face with clear white hair; small species.....14.  
 Hair of mesothorax not clear white.....15.
- 14.—Scutellum with yellowish hair (Calvinia).....*martini* Cockerell.  
 (*C. missionum* Cockerell falls near here, but the hair of mesothorax is a little yellowish, and the mesothorax is shining, with a strong median sulcus in front, whereas in *C. martini* it is dull except on disc posteriorly, and there is no such sulcus.)
- Scutellum with white hair (Graaff-Reinet).....*martini* Cockerell, variety.
- 15.—Malar space very short; small species with hair of mesothorax grayish white or faintly yellowish.....16.  
 Malar space longer; mostly larger species, with red hair on thorax above..17.
- 16.—Hair of scutellum pale reddish (Southern Rhodesia).....*callaspis*, n. sp.  
 Hair of scutellum not reddish (Natal coast).....*rugibasis*, n. sp.
- 17.—Hair of thorax above white with a faintly yellowish tint; abdomen broad; wings reddish.....*malleatus* Cockerell.  
 Hair of thorax above faintly yellowish; much smaller species; wings not at all reddish.....*hirtibasis*, n. sp.  
 Hair of thorax above reddish, usually bright ferruginous.....18.
- 18.—Abdomen distinctly narrower than thorax, shining.....*michaelis*, n. sp.  
 Abdomen as broad as or broader than thorax.....19.
- 19.—Second tergite shining.....*marleyi* Cockerell.  
 Second tergite dull.....20.
- 20.—Abdominal bands ochreous.....*latibasis*, n. sp.  
 Abdominal bands grayish white (Graaff-Reinet).....*opaciventris* Friese.

Friese (1925, Zool. Jahrb., XLIX, pp. 521-523) gives a table for the separation of African *Colletes*. The American Museum obtained from Friese a series of these bees, and I made the following table. The localities cited are those of the specimens examined.

- 1.—Hind tibiae and tarsi, and apical part of femora, clear red; mesothorax and scutellum with dark hairs intermixed; tegulae red; flagellum black (Cape Town).....*claripes* Friese, male.  
 Hind tibiae not thus red or, if red, with posterior black stripe (*C. transvalensis*), then thorax above with red hair, not mixed with dark.....2.
- 2.—Hair of mesothorax not red or fulvous.....3.  
 Hair of mesothorax red or fulvous.....7.
- 3.—Tergites 2 to 4 with very broad bands of orange tomentum (Giftsberg, Rhynsdorp).....*latefasciatus* Friese, female.  
 Tergites without orange bands.....4.
- 4.—Larger; abdominal bands very narrow; thorax posteriorly with light fulvous hair, anteriorly with pure white; hind femora beneath with an obliquely placed, even straight brush of red hair (Steinkopf).....*schantzei* Friese, male.  
 Abdominal hair-bands rather broad.....5.

- 5.—Very small, with pure white hair; flagellum red beneath; hind basitarsi not red basally (Faydm).....*nanus* Friese, male.  
Larger; hind basitarsi red at base; flagellum not red beneath.....6.
- 6.—Stigma clear light fulvous; second cubital cell very broad (Bushmanland).  
*opacigenalis* Friese, male.  
Stigma much smaller, and dark (Montagu, Cape Province).  
*breviceps* Friese, male.
- 7.—Females.....8.  
Males, all with dark flagellum.....12.
- 8.—Mandibles red in middle; tegulae clear red; stigma dusky red; abdominal bands broad and gray (Salisbury, Southern Rhodesia).  
*parafodiens* Friese, 1925.  
Mandibles not or hardly red in middle.....9.
- 9.—Hair of face clear white; hair of scutellum very bright red.....10.  
Hair of face yellowish.....11.
- 10.—Face very broad (Karibib).....*volkmanni* Friese.  
Face narrower, orbits converging (Mfongosi, Zululand)....*zuluensis* Friese.
- 11.—Hind tibiae and tarsi partly rufescent; hair of scutellum very bright red (Zeerust, alt. 3869 ft.).....*transvalensis* Friese.  
Hind tibiae and tarsi dark; hair of scutellum fulvous (Mulango).  
*rufitarsis* Friese, variety.
- 12.—Wings suffused with reddish; nervures dark; face with long dull white hair (Salisbury, Southern Rhodesia).....*opacicollis* Friese.  
Wings not distinctly reddish.....13.
- 13.—Stigma very small and dark; hair of face and front all fulvous (Mulango).  
*rufitarsis* Friese.  
Stigma red or reddish.....14.
- 14.—Stigma clear fulvous without dark margin; second cubital cell parallel-sided, receiving recurrent nervure much before middle (Capland).  
*opaciventris* Friese.  
Stigma red, with dark margin.....15.
- 15.—Stigma longer (Mfongosi, Zululand).....*cindellus* Friese.  
Stigma shorter, obliquely truncate (Harar, Abyssinia)....*abessinicus* Friese.

The last two are very much alike.

*C. opacus* Friese is described in the paper cited above, but omitted from the table.

I also possess many of the Friese species, received from Friese.

#### *Colletes antecessus* Cockerell

Kirstenbosch, near Cape Town, November 18, 1933 (J. Ogilvie).

#### *Colletes bukavanus*, new species

MALE.—Length about 10.5 mm., anterior wing 7.9; black, rather robust, labrum black, with a large pit; mandibles black, with a red zone in middle; tegulae fulvous; flagellum very obscurely reddish beneath; legs black, the tarsi dusky rufous; hair of head and thorax long and abundant, dull white on cheeks and lower part of thorax, clear white on lower part of face, but on upper part, and on vertex, tinged

with red; thorax above, and region of tubercles, with pale red hair, not brighter on scutellum, sparingly mixed with brown on disc of mesothorax and on scutellum; face broad, eyes not much converging below; malar space as long as broad; clypeus shining, with well-separated punctures, but largely hidden by the long hair; mesothorax shining, with well-separated punctures, median groove distinct; scutellum rough and dull; area of metathorax with strong plicae and a transverse keel; wings reddish hyaline; stigma and nervures dusky reddish; second cubital cell rather strongly contracted above, receiving recurrent nervure a little beyond the middle; felt-like hair on hind tibiae posteriorly very light, so that when the tibiae are seen from the outer side, the hind margin is marked by a white stripe; abdomen with six moderately broad, dull whitish hair-bands, on more or less testaceous margins; first tergite densely and minutely punctured, a little shining, and covered with long, slightly fulvescent hair; some short black hair on discs of third and following tergites; the abdomen in general is rather conspicuously shining; venter with well-developed pale bands.

Belgian Congo: Bukavu, August 10, 1931 (Alice Mackie). To be compared with *C. sordescens* Cockerell, which differs by the much narrower and whiter abdominal bands. In Friese's table it runs to *C. opacigenalis* Friese, which has quite different wings and pubescence.

#### *Colletes callaspis*, new species

FEMALE (type).—Length about 10 mm., anterior wing 7; robust, black, including legs, except that last joint of tarsi is red; mandibles with apical half obscurely reddish, inner tooth feeble; malar space extremely short; clypeus very coarsely and densely punctured; face broad; flagellum very obscurely brownish beneath; ocelli widely separated; face, cheeks, and sides of thorax with rather dull white hair, but snow-white at sides of face; mesothorax dull, except disc posteriorly, which is broadly exposed, impunctate and brilliantly polished; scutellum shining in front; descending (apical) part of area of metathorax shining, crossed by widely spaced, gently arched, raised lines; upper part with plicae, largely hidden by the abundant hair; no dark hair on thorax above; mesothorax with short, faintly fulvescent hair, scutellum with clear light ferruginous; tegulae rufous; wings hyaline, faintly dusky but slightly milky; stigma red with a dark margin, nervures dark brown; second cubital cell receiving recurrent nervure in middle; legs with whitish hair, reddish on inner side of tarsi; middle femora with a strong dentiform angle beneath; abdomen moderately shining, not polished; first tergite with strong close punctures, second with very much smaller punctures; first four tergites with white hair-bands, that on first overlapping base of second; margins of sternites shining, with very weak hair-bands.

MALE.—Length about 8 mm.; antennae black; malar space slightly longer than in female, but very short; wings distinctly milky; venter of abdomen with much white hair; abdomen with five light bands.

Southern Rhodesia: Matopo Hills, April 17–30, 1932 (L. Ogilvie). The female is extremely like *C. cinctellus* Friese, from Salisbury, Southern Rhodesia (D. Dodds), received from Friese. It differs from this *C.*

*cinctellus* by the contrasting colors of mesothorax and scutellum (well shown in both sexes) and more distinctly punctured first tergite. However, *C. cinctellus* was described from Zululand, and said to have reddish legs and dusky wings; I doubt whether the Salisbury insect is the same species.

***Colletes fusconotus* Cockerell**

Natal: Merebank, October 16, 1931, two females (Cockerell, J. Ogilvie).

***Colletes hirtibasis*, new species**

MALE.—Length about 8.5 mm., anterior wing 6; rather slender, black, including antennae and legs, except that the tarsi are red at apex; head broad and short; malar space about twice as broad as long; tubercles at base of mandibles very prominent; mandibles red at end; clypeus and mesothorax shining, but well punctured; scutellum shining between punctures; base of metathorax, above the transverse keel, finely pitted and wrinkled, without distinct parallel plicae; head and thorax densely covered with long hair, dull white on cheeks and under side of thorax, creamy white on face, pale yellowish on thorax above, the scutellum not contrasting with mesothorax; tegulae rufous; wings hyaline; stigma light red, the border darker; nervures pale red, the marginal cell bounded by a dark nervure; second cubital cell only moderately broad, receiving recurrent nervure at middle; legs with white hair, pale yellowish on inner side of tarsi; first tergite dull, very densely and finely punctured, but the punctures visible under a lens; following tergites finely punctured, somewhat glistening; six broad shaggy yellowish hair-bands; first tergite with very long pale hair all over, second with long pale hair in middle; no black hair before the bands; venter with pale hair-bands; third and fourth sternites each with a large triangular whitish area.

Cape Province: Ceres, February 12–18, 1932 (Alice Mackie). This is much smaller than *C. opaciventris* Friese, and differs by the long light hair on second tergite. By this character it resembles *C. volkmanni* Friese, but differs from that by the dark tarsi and pale hair of scutellum.

***Colletes latibasis*, new species**

MALE.—Length about 10 mm., anterior wing 7.2; black, rather robust, apical half of mandibles obscurely reddish, antennae entirely black, tegulae light rufotestaceous, legs black, the tarsi rufescent apically, the hind basitarsi obscurely reddish; hair of thorax above long, bright fox-red, with no admixture of dark hairs; hair of head and thorax otherwise pale fulvous, a little brown about ocelli, whitish (but not white) on cheeks and lower part of face; malar space large, but not as long as broad; face broad; clypeus shining between the strong punctures; mesothorax entirely dull, with a minutely granular surface; scutellum narrowly shining along anterior edge; area of metathorax triangular, the base with fine close plicae, the middle crossed by a transverse ridge [*C. malma* (Cameron) has a triangular area, which is dull, with a small shining triangle, with a median plica, at basal middle]; wings dusky, with small red dark-margined stigma, and dark brown nervures;



second cubital cell very broad, receiving recurrent nervure at middle; legs with pale fulvescent hair; abdomen broad, the first tergite unusually short and broad, glistening in middle, but extremely finely densely punctured; the other tergites also glistening, with extremely minute close punctures, the dark parts with long black hairs; five broad even fulvous marginal bands, that on first tergite like the others; venter with broad bands.

Cape Province: Cape Town (type locality), April 4, 1920 (Michael Bequaert). Orange Free State: Ficksburg, February–March, 1932 (J. Ogilvie). Related to *C. mitescens* Cockerell, but quite distinct by the broader abdomen; shorter, relatively broader, first tergite; broader hair-band on first tergite; plicae at base of metathorax much more numerous; and larger and broader head. It is near to *C. opaciventris* Friese, but larger, with darker wings and venation, dark-margined stigma, details of venation, etc.

#### *Colletes malleatus* Cockerell

Southern Rhodesia: Vumba, Umtali, May 23–26, eight females (J. Ogilvie, L. Ogilvie, A. Mackie).

From this locality come numerous females, all at first sight appearing the same. First of all, it is possible to separate *C. marleyi*, on account of the conspicuously punctured first tergite. The residue gave me some trouble. At one extreme stood specimens with polished first tergite, and some dark hairs mixed with the light on thorax above. These are *C. sordescens* Cockerell, 1933. But they appeared to grade into a series with dull first tergite, through examples in which the second tergite was dull but the first distinctly shining. I found, however, that the outer intercubitus in both sexes of *C. sordescens* had a double curve, but in *C. malleatus* Cockerell, based on the male from Vumba, this was not distinctly the case. All the females, except those already assigned as above, had the *malleatus* venation, and I refer them to that species with some confidence. In the table of males in Entomologist, September, 1933, p. 207, these females run exactly to *malleatus*, having the reddish wings and black hair before the abdominal bands. Against the reference to *C. malleatus* are two characters, the malar space is much shorter, and the first tergite is not so finely roughened. But comparison of the sexes of *C. succinctus* shows that these are presumably sexual characters.

#### *Colletes marleyi* Cockerell

Southern Rhodesia: Vumba and Christmas Pass, Umtali, May, females (J. Ogilvie). The well-punctured first tergite resembles that of the European *C. succinctus* (Linnaeus). *C. malma* (Cameron) has the

sagittae of the male genitalia formed much as in *C. marleyi*, broadly obliquely truncate at end. It was described as an *Andrena*.

#### *Colletes martini* Cockerell

In 1932 I recorded this from Calvinia and Graaff-Reinet. The rest of the series having been mounted, I note that 16 males from Calvinia have the scutellum with yellowish hair (thus resembling the type), but 13 from Graaff-Reinet have this hair white. I thought it possible that there might be two species, but the genitalia and seventh ventral plate do not differ. The genitalia are about as in *C. braccatus* Pérez. The dark inner sagittal rod runs to the end, and the broad wing is subtruncate at end, but with the outer apical corner rounded, gradually sloping away to the side. The seventh ventral plate is not at all as in *C. braccatus*, but is more like that of *C. montanus* Morawitz, with a strong dentiform projection on outer side near base. There is, however, a very good distinguishing character in a large rounded lateral lobe, bearing a regular fringe of long hair. The genitalia are quite distinct from those of *C. fascicularis* Cockerell, found at Nieuwoudtville. In that species the sagittal rods are very broad, broadly rounded and shining at end, while the broad dark wing has a rounded apical emargination, rather in the style of *C. abeillei* Pérez and *C. fodiens* Kirby.

#### *Colletes michaelis*, new species

MALE (type).—Length about 11 mm.; wings short, about 7 mm.; abdomen long and narrow, width about 2.7 mm., conspicuously narrower than thorax; black, with the mandibles red, black at base; flagellum long, black; tegulae light rufous; legs very dark brown, nearly black, including basitarsi, but the tarsi light reddish at end; middle and hind tibiae red at extreme end; malar space about twice as broad as long; face rather broad; head and thorax with abundant long hair, orange-ferruginous on head and thorax above, without dark hairs intermixed, pale fulvous on face, white on cheeks, pale fulvescent on sides of thorax; mesothorax dull, very densely and finely punctured, a little shining on disc posteriorly; scutellum shining in front; area of metathorax with the usual plicae, and a strong transverse keel; wings dusky hyaline; stigma red with a dark margin; nervures brown; second cubital cell much contracted above, receiving recurrent nervure about the middle; abdomen moderately shining, finely punctured, the punctures on first tergite distinct but dense; five entire hair-bands, which are pale grayish, slightly fulvescent, not very broad, the margins of tergites beneath them pallid; venter with narrow bands. The genitalia resemble those of *C. braccatus* Pérez, but the hyaline wings of the sagittae are very large and broad, broadly and obtusely rounded at end (not truncate as in *C. marleyi* Cockerell), extending somewhat beyond the ends of the inner dark rods; the stipites have a broad flattened base, with an apical process like the last joint of a finger, bearing long hairs; the volsella is large and round. *C. volsellata* Metz, from Mexico, is another species with similar genitalia.

**FEMALE.**—Length about 10 mm.; mandibles red with black base; clypeus with coarse elongate punctures, and a narrow median groove; flagellum red beneath except at base; hind tarsi red; abdomen very finely punctured, the bands of tomentum gray. The wings are quite strongly reddish.

Belgian Congo (Katanga): Lubumbashi (Michael Bequaert). Male, January 10; female, January 12, 1921. The abdomen (especially the first tergite) resembles that of *C. marleyi*, but it differs from that (male) by the longer flagellum, and narrower face with fulvescent hair. *C. parafodiens* Friese, female, from Southern Rhodesia, is smaller (9 mm.). malar space almost linear, tarsi fulvous, and abdominal bands yellow.

#### *Colletes missionum* Cockerell

Transvaal: Wonderboom, near Pretoria, October 4, 1931, male (J. Ogilvie). Described from the Katanga Mission, Belgian Congo. It closely resembles *C. opacigenalis* Friese, at first sight, but differs by the following characters: stigma larger and dark margined; nervures stronger and much darker; malar space much shorter; labrum clear red; head narrower; eyes brown; hair of mesothorax faintly yellowish; second tergite shining. The *C. opacigenalis* compared is one of the original lot, from Henkries, Bushmanland (Lightfoot). *C. missionum* is easily known from *C. fascicularis* Cockerell by the broader, shining, first tergite and red labrum.

#### *Colletes ogilviei*, new species

**FEMALE.**—Length about 10.5 mm., anterior wing 8; robust, black, the mandibles with the apical half very obscurely reddened; antennae black, the flagellum short; tegulae rufofulvous; legs black, with the tarsi red at end, the hind tarsi entirely obscurely reddish, and a little, hardly noticeable reddish suffusion at each end of hind tibiae; malar space very short but not linear; face broad, but orbits strongly converging below; clypeus dull and rough; hair of face, cheeks, and sides of thorax rather dull white; vertex with faintly reddish hair; mesothorax and tubercles with pale fulvescent hair, the disc of mesothorax with much black hair; scutellum with bright ferruginous hair, not mixed with black; mesothorax dull and rough, not polished anywhere; scutellum in front a little shining but closely punctured; base of metathorax with strong close plicae, crossed by an irregular band, and bounded below by a strong transverse keel; below the keel the surface is shining, with widely spaced plicae; wings hyaline, very faintly reddish, stigma red with a dark border, nervures dark brown; second cubital cell broad, but with strongly sloping sides, receiving recurrent nervure in middle; legs with mainly white hair, light red on inner side of tarsi; middle femora produced to a strong angle beneath; abdomen broad, moderately shining, the first tergite dorsally dull, with very fine and dense but distinct punctures; second tergite finely punctured but shining; tergites 2 to 5 with broad cinereous bands, first tergite with a narrow band, rather broad at sides, but very weak in middle; venter polished, the bands feebly developed.

Natal: National Park, March 3-15, 1932 (J. Ogilvie). It differs from *C. mitescens* by the much more distinctly punctured first tergite, narrower face, and mesothorax with conspicuous dark hair. The dull, closely punctured first tergite at once separates it from *C. sordescens*. It is very like the male of *C. opaciventris* Friese, but can hardly be its female, on account of the dark hair on mesothorax.

*Colletes rugibasis*, new species

MALE.—Length about 8.3 mm., anterior wing 6: black, with abundant white hair, having a faintly creamy tint on head and thorax above, and with no admixture of dark hairs; mandibles with the apical half red; malar space excessively short; face broad; antennae black, the flagellum thick; tegulae fulvous; mesothorax dull and minutely punctured, shining on disc posteriorly; scutellum with a smooth and polished space in middle; base of metathorax with close-set strong plicae; wings hyaline, somewhat milky, stigma red with a dark margin; second cubital cell very broad, receiving recurrent nervure about middle; legs black with red tarsi, and the hind tibiae partly red, the posterior face with about the apical and basal thirds red; abdomen broad at base; first tergite dull, densely and roughly punctured, with erect long white hair, and a rather broad apical white hair-band; tergites 2 to 5 with broad, even, pure white hair-bands; second tergite distinctly punctured and slightly glistening; some black hair before the bands on third and following tergites; sixth tergite appearing black, seventh covered with white tomentum; venter with well-developed white hair-bands.

Natal: Amanzimtoti, October 16, 1931 (J. Ogilvie). Very like *C. bevisi* Cockerell, but distinguished by the dull first tergite and shorter malar space. It is also very like *C. opacigenalis* Friese, differing by the dark nervures, dull and rough first tergite, and color of hair on thorax above. The nervures are practically black.

*Colletes ruwenzoricus*, new species

FEMALE.—Length about 11 mm., anterior wing 8; black, robust, with very broad face, black or nearly black eyes, mandibles with the apical half obscurely rufous; flagellum very obscurely brown beneath; tegulae ferruginous; legs mainly black, but hind tibiae dull reddish with a large black mark, tarsi red, the front and middle basitarsi largely blackened; hair of head long and abundant, white, slightly creamy on face and vertex; under side of thorax with white hair, but above, including the region about tubercles, it is fulvous, becoming very bright red on scutellum, but strongly mixed with black on posterior disc of mesothorax, and anterior middle of scutellum; legs with white hair, pale reddish on inner side of basitarsi; abdomen with five bands of appressed felt-like hair, which is dull fulvous, the band on first tergite rather narrow, on the others broad and even; first tergite with erect white hair at base and sides, the other tergites with some erect hair at extreme sides. Labrum shining, with a median groove; malar space short, more than twice as broad as long, but not linear; clypeus dull, with large punctures running in rows, a shining elevation, with a semicircular margin, just above the apex; mesothorax dull and densely punctured, but with a shining, sparsely punctured discal area; area of meta-

thorax with the usual plicae, and crossed by a strong keel; wings hyaline, faintly yellowish; nervures reddish, the outer ones darkened; stigma small, light red with a darker margin; second cubital cell very broad, receiving recurrent nervure a short distance beyond middle; middle femora with a strong angular process near base beneath; first tergite dull, extremely finely and densely punctured; second even more minutely punctured; third moderately shining; venter with narrow hair-bands.

Belgian Congo: Mt. Ruwenzori, 0° 30' N., 29° 50' E., altitude 1400 m., June 5, 1914 (J. Bequaert). Apparently related to *C. ruficollis* Friese, but that has the labrum red, the flagellum red beneath, the abdomen shining.

*Colletes sordescens* Cockerell

Southern Rhodesia: Vumba, Umtali, May 23-26, two females (J. Ogilvie).

*Colletes sororcula*, new species

FEMALE.—Length slightly over 10 mm., anterior wing 7.3; black, robust, the stout mandibles with an obscure reddish zone in middle, flagellum obscurely reddish beneath except at base; clypeus coarsely punctured, on the apical part shining between the punctures; malar space extremely short; face, cheeks, and sides of thorax with white hair, vertex with pale brown; thorax above with grayish-white hair, mixed with black on mesothorax, and more abundantly on scutellum; mesothorax dull and densely punctured, except the disc posteriorly, where it is shining, with a small impunctate space; scutellum shining in front; area of metathorax with a short basal zone having strong, rather close plicae; tubercles with dense, slightly fulvescent hair; tegulae rufofulvous; wings dusky, the stigma small and dark, nervures very dark brown; second cubital cell broad, receiving recurrent nervure at middle; legs black, with a good deal of dark or black hair, but front femora with long white hair behind, and hind femora with long bright orange-ferruginous hair beneath; abdomen shining, very minutely punctured, the punctures on first tergite numerous and easily visible with a lens, but still minute; hind margins of tergites not at all reddened; five grayish-white bands, even and rather broad, except the first, which is narrower and shaggy; white hair at extreme base of second tergite; tergites 3 to 5 with long black hairs before the bands; apical sternite rufescent.

Cape Province: Ceres, February 12-18, 1932 (Alice Mackie). Extremely similar in most respects to *C. glaucescens* Cockerell, but easily distinguished by the very short malar space. The abdomen is also different and has the bands better developed and the first tergite more punctured. There is some resemblance to *C. mackieae* Cockerell, but that is larger, with a quite different clypeus. The red hair on hind legs is as in *C. glaucescens*, and certainly the relationship to this species is very close. Although the size of the malar space is used in tables of *Colletes* to separate groups of species, it is a character which is liable to differ in the sexes of the same species, and in the same sex of closely related species.





# AMERICAN MUSEUM NOVITATES

Number 857

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

June 5, 1936

## AFRICAN BEES OF THE GENUS *NOMIOIDES*

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The present paper relates to the hitherto unreported material of the Cockerell-Mackie-Ogilvie Expedition of 1931-1932. The types of the new species will be found in The American Museum of Natural History. In dealing with this genus, I have necessarily used the excellent papers by Blüthgen (1925, Stettiner Entomologische Zeitung, LXXXVI, 100 pp.; 1933, Mem. Soc. Entomologica Italiana, XII, pp. 114-127; 1934, Stett. Ent. Zeitung, XCV, pp. 238-283). It may be useful to state that the large paper of 1925 was received in Boulder, September 23, 1925.

When dealing with the *Nomioides* fauna of Morocco, I separated some forms, closely related to those already described, but apparently distinct and oligotropic on particular plants, like our American species of *Perdita*. Blüthgen does not accept these conclusions, and there can be no doubt that more information is needed in order to settle the problems involved. Miss Louise M. Ireland (1935, Annals of Transvaal Museum, pp. 95-107) has figured the genitalia of *N. variegata* (Olivier), *N. luderitzi* (Blüthgen) and *N. muiri* Cockerell, and they are different enough to suggest that these are three valid species, though Blüthgen is convinced that the two latter are no more than varieties of *N. variegata*. *N. halictoides vernayi* Cockerell and Ireland, from the Kalahari Desert, is regarded as a subspecies of *N. halictoides* Blüthgen, but even this shows certain minor differences in the genitalia. Thus it seems probable that intensive biological and morphological studies will reveal a very interesting state of affairs, with many closely related or incipient species.

### *Nomioides* (*Cellariella*) *atomella*, new species

MALE.—Length hardly over 3 mm., anterior wing 2.7; black, with the markings nearly white. It differs from *N. somalica* Magretti by its minute size; flagellum black above, dusky reddish brown beneath; first tergite entirely black, second and third with broadly interrupted bands, that on second reduced to a pair of elongate marks; hind tibiae with rather more than the apical half black; mandibles black at base, without a yellow spot. The second cubital cell is petiolate above; postscutellum with a light band as in typical form; clypeus yellow (reddened by cyanide in type), without spots; scape with a pale stripe in front.

Belgian Congo: 60 kilometers south of Bukavu, August 28 (Alice Mackie).



**Nomioides callonotus**, new species

**FEMALE.**—Length about 4 mm., anterior wing 3.3; head round seen from in front, rather dark bluish green, with rather conspicuous short pale hair; mandibles bright red with dark tip and pale yellow base; labrum pale yellowish; clypeus black, with an obscure apical yellow band, which is connected with a pair of very widely separated short vertical bands; sides of front and face shining; scape broadly light yellow in front; flagellum short, pale testaceous beneath; mesothorax dullish, very brilliant Prussian green; the rest of the thorax obscure bluish green, without light marks, except that the tubercles are margined with yellow; tegulae hyaline; wings perfectly clear, appearing rather milky; stigma hyaline, with a very pale yellowish margin; nervures colorless, marginal cell very narrowly truncate at end; second cubital cell much narrowed above; first recurrent nervure meeting second intercubitus; femora black, with the knees narrowly pale; tibiae and tarsi pale reddish, the tibiae with black marks, minute on first, larger on second, very large on third; abdomen broad, black, first two tergites with rufous hind margins, overlapping basal yellow bands on second and third; third with a whitish margin, overlapping a red band; fourth and fifth with hyaline margins.

Cape Province: Ceres, February 12–18, 1932 (L. Ogilvie). Related to the North African *N. turanica* Morawitz, but distinguished by the clypeal mark, the brilliant green mesothorax, and other characters.

**Nomioides fasciata** Fries

Sudan: Port Sudan, June, 1932, five males (J. Ogilvie). Easily known from *N. variegata* by the tergites 2 to 6 having yellow bands, and the scutellum and postscutellum more or less marked with yellow.

**Nomioides halictoides** Blüthgen

Cape Province: George, one female, November (J. Ogilvie); Ceres, one female, February (A. Mackie); Blaukrans, near Calvinia, one male, November (J. Ogilvie).

**Nomioides maculiventris** (Cameron)

Cape Province: Calvinia, November, two females and a male (J. Ogilvie); Doorn River, November, one female (J. Ogilvie); Van Rhyns Pass, one female, November (W. P. Cockerell); Oudtshoorn, two females, October (Cockerell); Uitenhage, three females, October (A. Mackie); Nieuwoudtville, November, one female (A. Mackie).

In American Museum Novitates, No. 547, I said that the yellow of female scutellum was not at all notched, but on examining a long series, I find it very frequently notched behind. Blüthgen has mentioned this error in Stett. Ent. Zeit., 1934, p. 251, footnote.

**Nomioides (Cellariella) somalica Magretti**

This very widely distributed species is variable, and may prove to consist of more than one. Specimens now before me separate out as follows:

- 1.—Male: clypeus pale yellow without black spots; markings of abdomen white; band on second tergite very widely interrupted, reduced to a long pyriform mark on each side; band on third tergite narrowly interrupted, and the other tergites black without bands; mandibles yellow, red at end. Lobito Bay, Angola, July 19–20, 1931 (A. Mackie).....*somalica* Magretti.  
Females.....2.
- 2.—Larger, length about 5.5 mm.; mandibles black at base, with only a minute yellow spot; front and middle femora with only the knees yellow; hind tibiae black, with much white hair; median spot on first tergite small; second tergite with a large spot on each side, these connected with a slender band across the base; third tergite with a broad, entire band; the other tergites with narrower bands; clypeus with two black spots. Nata River, Kalahari, August 24–27, 1930 (Van Son, Vernay-Lang Expedition).....*kalaharica*, n. subsp.  
Smaller, length about 4.5 mm.; mandibles yellow at base and red beyond; hind tibiae light yellow, with a large or small black mark.....3.
- 3.—Clypeus with two black spots; all the light markings of head, thorax and abdomen very pale, hardly at all yellowish; scutellum entirely black; front and middle femora with light knees; median spot on first tergite a transverse bar; second tergite with the band broadly interrupted, on the other tergites it is entire. Benguela, Angola, July, 1931 (A. Mackie).....*somalica* Magretti.  
Clypeus without black spots; light markings pale yellow; scutellum with a slender interrupted band posteriorly; front and middle femora broadly yellow at apex; median spot on first tergite large; band on second and following tergites broadly entire. Usakos, Southwest Africa, January 16, 1934 (L. Ogilvie).....*completa* Blüthgen.

All these have the second cubital cell petiolate above; in the Angola specimens the first recurrent nervure meets second intercubitus, but in the Usakos one it joins the third cubital cell.

**Nomioides variegata (Olivier)**

Sudan: Port Sudan, June, 1932, one male and two females (J. Ogilvie).

Belgian Congo: Uvira, August 28–29, 1931, one female (abdomen lost) and two males (A. Mackie, J. Ogilvie).

Southern Rhodesia: Shangani, De Beers Ranch, May, 1932, one male (J. Ogilvie).

Transvaal: Louis Trichardt, April, 1932, one male (J. Ogilvie).



# AMERICAN MUSEUM NOVITATES

Number 858

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

June 8, 1936

## DESCRIPTIONS OF NEW AMERICAN SPIDERS

BY W. J. GERTSCH AND WILTON IVIE

In the following pages twenty-three new species of American spiders are described. Another specific name has been proposed for *Dictyna armata* Banks, a name preoccupied by Thorell in 1875. *Filistata crassipalpus* Gertsch has been made the type of a new genus, *Filistatinella*. Unless otherwise indicated the types of the new species are deposited in the Collection of The American Museum of Natural History.

### Filistatidae

#### FILISTATINELLA, NEW GENUS

Carapace as broad as long, suborbicular in outline, very weakly convex, the longitudinal furrow a deep groove. Eye group elevated on a low tubercle. Eye rows equal in width, the first one procurved, the medians separated by half their radius, much smaller and equally distant from the much larger laterals (13/9). Second eye row straight, the medians separated by a diameter, subcontiguous with the subequal laterals. Median ocular quadrangle three-fourths as long as broad. Sternum and labium about as broad as long. Leg formula, 1423, the femora not much longer than the carapace. Legs without ventral spines.

GENOTYPE.—*Filistata crassipalpus* Gertsch (1935, American Museum Novitates, No. 792, p. 5).

#### *Filistata arizonica* Chamberlin and Ivie

*Filistata arizonica* CHAMBERLIN AND IVIE, 1935, Bull. Univ. Utah, XXVI, (No. 4), p. 4, Pl. IV, figs. 24 and 25.

RECORD.—Ruins near Tucson, Arizona, July and August, 1935, males and females (Peter Steckler).

### Pholcidae

#### *Psilochorus hesperus*, new species

Figures 1 to 5

FEMALE.—Total length, 3.80 mm. Carapace, 1.20 mm. long, 1.20 mm. wide.

Integument of the carapace dull yellow, the clypeus infuscated, the eyes ringed in black, the cephalic sutures blackened. Carapace as broad as long, the sides sparsely clothed with inconspicuous hairs, the head with a few spines behind the eye group. Head strongly elevated above the clypeus and the pars thoracica. Sutures deep, the median one halted before reaching the caudal margin. Eyes of the first row procurved, a line through the centers of the medians cutting the upper edge of the laterals. Anterior median eyes very small, half the diameter of the lateral, separated

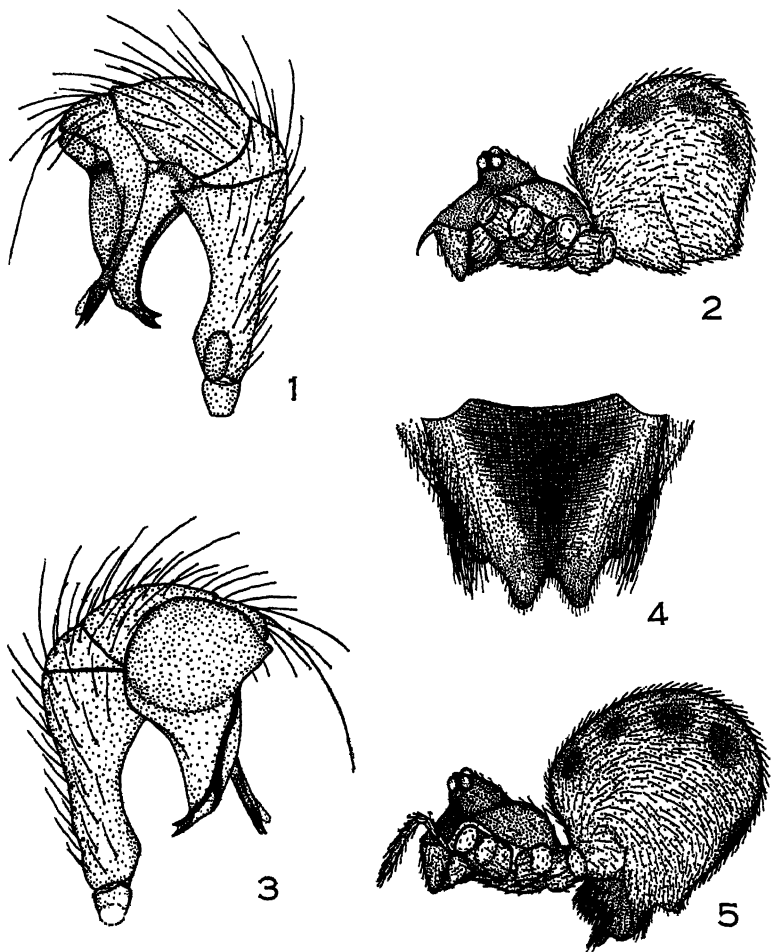


Fig. 1. *Psilochorus hesperus*, new species, palpus, prolateral view.  
Fig. 2. Idem, side view of male, legs omitted.  
Fig. 3. Idem, palpus, retrolateral view.  
Fig. 4. Idem, epigynum.  
Fig. 5. Idem, side view of female, legs omitted.

by scarcely a radius, as far from the laterals. Eyes of the second row very slightly recurved, virtually straight, the medians subcontiguous with the equal laterals, separated by one and one-third times their diameter. Median ocular quadrangle much broader than long (30/26), greatly narrowed in front (30/13), the anterior medians one-half the diameter of the posterior medians. Clypeus sloping, as high as the width of the ocular area. Sternum much broader than long (9/6), truncated in front, gently rounded on the sides and behind where the posterior coxae are separated by their width. Labium much broader than long (27/10), subquadrangular in outline. Under parts sparsely clothed with erect spines. Femur of the first leg four times as long as the carapace. Abdomen subglobose, mainly gray, with inconspicuous blue markings. Epigynal ridges prominent, armed with two subcontiguous or more widely separated lobes.

MALE.—Structure and size essentially as in the female but the clypeus longer and more sloping. Chelicera with a curved basal spur much as in *Psilochorus utahensis* Chamberlin. Palpus as figured.

TYPE LOCALITY.—Female holotype and two paratypes from Pullman, Washington, August. Male allotype and female paratype from Notus, Idaho, June 11, 1931 (W. Ivie).

This distinctive species can be confused in the female only with *Psilochorus rockefelleri* Gertsch from Arizona which also has the epigynal ridges armed with two lobes. *P. hesperus*, new species, is much larger in size and has the epigynal lobes more strongly developed as illustrated in the figure.

## Dictynidae

### *Argennina reclusa*, new species

Figures 19 and 20

FEMALE.—Total length, 2.47 mm. Carapace, 0.90 mm. long, 0.70 mm. wide.

Carapace very pale yellowish brown, sparsely clothed with fine hairs, the eyes ringed in black. Chelicerae light brown. Sternum and legs pale yellowish, the labium and endites darker. Legs clothed with black hairs. Abdomen gray to pale yellow, evenly clothed with procumbent black hairs.

Carapace longer than broad, moderately high, evenly convex, the median and cephalic sutures obsolete. Width of the pars cephalica at the second eye row about two-thirds the greatest width of the carapace. Eyes of the first row very weakly procurved, virtually straight, the medians separated by one-fourth their diameter, about as far from the larger laterals. Eyes of the second row straight, the medians separated by a diameter, two-thirds as far from the subequal laterals. Median ocular quadrangle broader than long (14/10), narrowed in front (14/9), the anterior medians smaller. Clypeus equal in height to a diameter of the anterior median eye. Chelicera with four tiny teeth on the lower margin. Sternum longer than broad (56/45), bluntly pointed behind, the posterior coxae separated by two-thirds their length. Labium longer than broad (18/16), two-thirds as high as the parallel endites. Legs without spines, the first tibia and patella shorter than the carapace (7/9). Epigynum as figured.

**TYPE LOCALITY.**—Female holotype from ten miles north of Cove Fort, Utah, taken April 15, 1932, by Mr. Wilton Ivie and in the collection of the University of Utah.

This species is closely related to *Argennina unica* Gertsch and Mulaik but is much smaller, has four teeth on the lower cheliceral margin, and differs in the details of the epigynum.

*Dictyna callida*, new species

Figures 6 to 8

**MALE.**—Total length, 1.70 mm. Carapace, 0.85 mm. long, 0.60 mm. wide.

This small species belongs to the *foliacea* group. Carapace and chelicerae chestnut. Endites, labium and sternum yellowish brown. Legs light yellowish, with faint indications of darker annulae. Abdomen with the sides dark gray, the median longitudinal area above pale grayish yellow, this area enclosing a blackish mark of the usual shape on the basal third—a short median black band, which expands into three blunt points posteriorly. Venter whitish. Epigastric area and spinnerets light brownish yellow.

Structure typical. The palpus has a thick embolus as in *foliacea* and other members of the group, but the tip of the embolus, along with other features, serve to distinguish this species. Tibia and patella I, 0.87 mm., IV, 0.58 mm. long.

**TYPE LOCALITY.**—Male holotype from Edinburg, Texas, October 22, 1934 (S. Mulaik), in the collection of the University of Utah.

*Dictyna horta*, new species

Figures 10 and 11

**MALE.**—Total length, 1.20 mm. Carapace, 0.60 mm. long, 0.48 mm. wide.

Color uniform light orange-brown to bright reddish brown. Carapace clothed sparsely with black hairs, the midline of the cephalic portion with several long ones. Carapace longer than broad, moderately high, the convex pars thoracica suborbicular in outline, the pars cephalica higher, more strongly convex, gently sloping caudad. Cervical groove and striae weakly indicated. Sternum cordate, as broad as long (36/36), truncated in front, bluntly rounded behind where the fourth coxae are separated by their length. Labium broader than long (17/12). Legs without spines, clothed evenly with rather long black hairs. Tibia and patella of the first leg slightly shorter than the carapace (0.75 mm./0.69 mm.).

First row of eyes straight as viewed from in front, the medians separated by scarcely a diameter, half as far from the slightly larger laterals. Second row of eyes very weakly recurved, the medians separated by their diameter, as far from the subequal laterals. Median ocular quadrangle broader than long (14/12), slightly narrowed in front (14/12), the eyes subequal. Front rounded, the clypeus slightly sloping, equal in height to twice the diameter of an anterior median eye. Palpus as figured.

**FEMALE.**—Total length, 1.38 mm. Carapace, 0.60 mm. long, 0.46 mm. wide. Color and structure essentially as in the male, with allowance for the usual sexual differences.

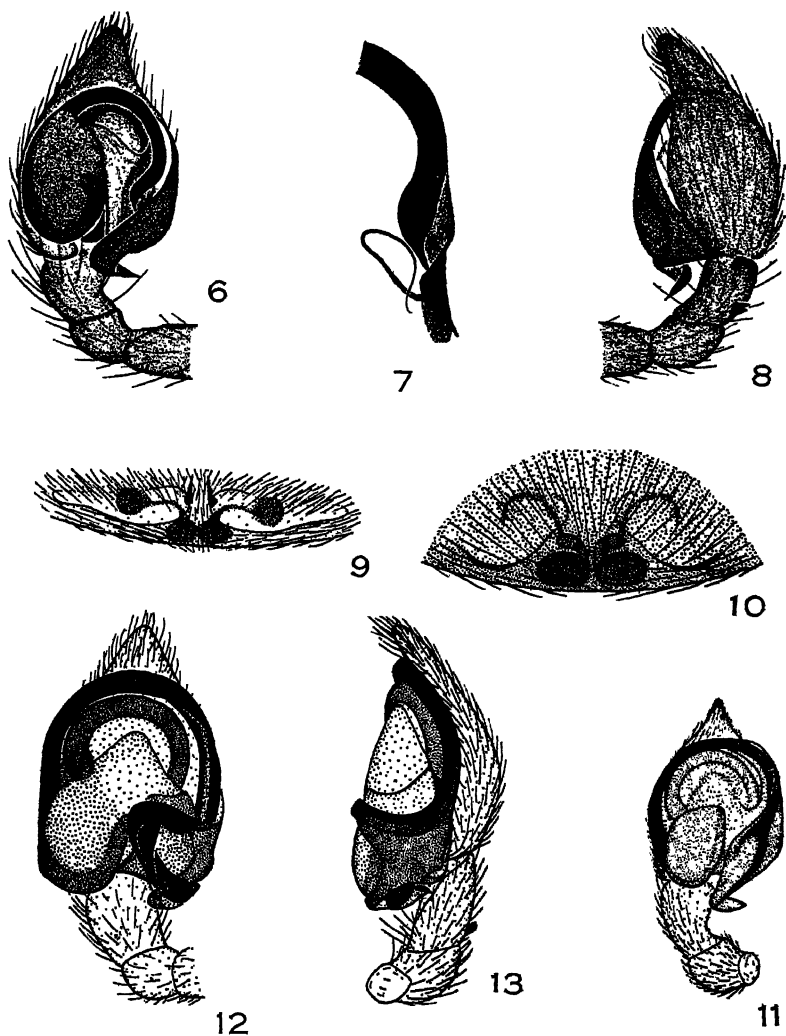


Fig. 6. *Dictyna callida*, new species, palpus, ventral view.

Fig. 7. Idem, tip of embolus of palpus.

Fig. 8. Idem, palpus, prolateral view.

Fig. 9. *Dictyna cambridgei*, new species, epigynum.

Fig. 10. *Dictyna horta*, new species, epigynum.

Fig. 11. Idem, palpus, ventral view.

Fig. 12. *Dictyna consuta*, new species, palpus, ventral view.

Fig. 13. Idem, palpus, prolateral view.



TYPE LOCALITY.—Male holotype, female allotype and paratypes from Notus, Canyon County, Idaho, September 18, 1933 (W. Ivie). Male and immature female paratypes from Itasca Park, Minnesota, May 29, 1932 (W. J. Gertsch).

This tiny species, which is smaller and paler than *Dictyna rubra* Emerton, has the posterior median eyes separated by their full diameter (decidedly less in *rubra*), and has the receptacula seminis oval, rather than orbicular in outline. In the male palpus the dorsal tibial spur is much shorter than in *D. rubra*, and the conductor of the embolus is distinctive as illustrated in the figure.

### *Dictyna consulta*, new species

Figures 12 and 13

MALE.—Total length, 2.00 mm. Carapace, 0.85 mm. long, 0.67 mm. wide.

Carapace pale yellowish brown, sparsely clothed with pale hairs, the pars thoracica darker, with a narrow black marginal seam, the sides with black markings at the position of the striae. Eyes ringed with black. Sternum pale yellowish brown, margined with black and with a dark median streak. Labium infuscated. Coxae and legs uniform yellow in color but the last pair with indistinct, incomplete darker rings. Abdomen mainly white to gray above, clothed with white hairs, with a small dark marking at the base and a stripe on each side made up of three or more irregular small black spots. Venter with a median dark band. In the paratype from Blackwell, Texas, the whole spider is paler and most of the usual markings are obsolete.

Carapace longer than broad, the pars thoracica a broad oval in outline, the cephalic portion elevated, the striae poorly indicated. Eyes of the first row straight, the medians separated by four-fifths their diameter, half as far from the subequal laterals. Eyes of the second row slightly recurved, the medians separated by two-thirds their diameter, as far from the equal laterals. Median ocular quadrangle as broad as long, very slightly narrowed in front, the anterior medians smaller. Clypeus one and one-third times as high as the diameter of an anterior median eye. Chelicerae excavated on the inner side. Sternum longer than broad (50/47), cordate, bluntly rounded between the posterior coxae, which are separated by their width. Labium as broad as long. Tibia and patella of the first leg longer than the carapace (1.05 mm.).

TYPE LOCALITY.—Male holotype from Lake Minnetonka, near Minneapolis, Minnesota, June 4, 1932 (W. J. Gertsch). Male paratype from Blackwell, Texas, August 16, 1929. Male paratype from Comanche County, Oklahoma.

This species has a superficial resemblance to *Dictyna mulegensis* Chamberlin but is quite distinct in the palpus, the tibia of which has only a small dorsal spur and is without the prolateral tubercular spur of *mulegensis*.

*Dictyna reticulata*, new species

## Figure 27

MALE.—Total length, 3.00 mm. Carapace, 1.35 mm. long, 1.10 mm. wide.

Carapace very pale yellowish brown, slightly infuscated in the head region, the eyes narrowly ringed in black. Clypeus clothed with long white hairs, the remainder of the carapace rubbed but apparently once covered sparsely with white hairs. Sternum pale yellow, margined with black and with an inconspicuous median dark streak. Labium and chelicerae light brown. Coxae and legs concolorous with the carapace, immaculate, clothed with inconspicuous fine black hairs. Dorsum of abdomen gray to silvery white, with fine dark reticulations, the venter slightly infuscated, the whole abdomen clothed with white hairs.

Carapace longer than broad, the thoracic part a broad oval, the pars cephalica convex, well elevated, the median suture weakly indicated, the other sutures virtually obsolete. Clypeus sloping, as high as the median ocular quadrangle. Pars cephalica weakly curved in front, the sides of the head as seen from above parallel. Eyes of the first row straight as seen from in front, recurved from above, the medians separated by two-thirds their diameter, scarcely separated from the subequal laterals. Eyes of the second row very weakly recurved, the medians separated by one diameter, as far from the subequal laterals. Median ocular quadrangle slightly broader than long, equally wide in front as behind, the eyes subequal. Chelicerae strongly excavated on the inner side. Sternum cordate, longer than broad (40/35), truncated in front, broadly rounded on the sides, bluntly pointed between the posterior coxae which are separated by their width. Labium longer than broad (30/27). Tibia and patella of the first leg longer than the carapace (1.90 mm.). Palpus as figured.

TYPE LOCALITY.—Male holotype from Richfield, Utah, August 14, 1930 (W. J. Gertsch). Paratypes from four miles southwest of Santa Clara, Utah, May 2, 1930 (D. E. Fox). Paratypes from Adelaide, Idaho, May 27, 1932 (D. E. Fox).

*Dictyna phylax*, new species

## Figures 29 and 30

MALE.—Total length, 2.50 mm. Carapace, 1.30 mm. long, 0.90 mm. wide.

Carapace uniform reddish brown in color, the eyes narrowly ringed in black. Sternum and mouth parts reddish brown. Legs slightly paler. Abdomen imperfect, apparently uniformly colored as the carapace.

Carapace much longer than broad, the thoracic portion orbicular in outline, convex, the pars cephalica very high, strongly convex, highest behind the ocular area. Clypeus as high as the height of the ocular quadrangle. Pars cephalica prominent, slightly rounded in front, the sides as seen from above rounded. Eyes of the first row straight from in front, recurved as viewed from above, the medians separated by more than a diameter (8/6), half as far from the larger laterals. Eyes of the second row recurved, a line through the centers of the laterals touching the posterior margin of the medians, the medians separated by slightly more than a diameter, as far from the laterals. Median ocular quadrangle broader than long (23/20), narrowed in front in the same ratio, the posterior eyes larger (9/6). Chelicerae curved, not much excavated on the inner side. Sternum longer than broad

(35/30), truncated in front, rounded on the sides, bluntly pointed between the posterior coxae which are separated by their width. Labium longer than broad (28/25), three-fourths as high as the endites. Tibia and patella of the first leg longer than the carapace (1.40 mm.). Tibia of the male palpus with a very short spur above at the base. Palpus as figured.

TYPE LOCALITY.—Male holotype and immature female allotype from Itasca Park, Minnesota, May 29, 1932 (W. J. Gertsch). Male paratype from Medicine Hat, Alberta, 1930 (Carr).

This species agrees rather well in color and structure with *Dictyna volucripes* Keyserling but is immediately separated by the very short tibial apophysis of the male palpus and the details of the bulb which is figured.

*Dictyna vigilans*, new species

Figure 26

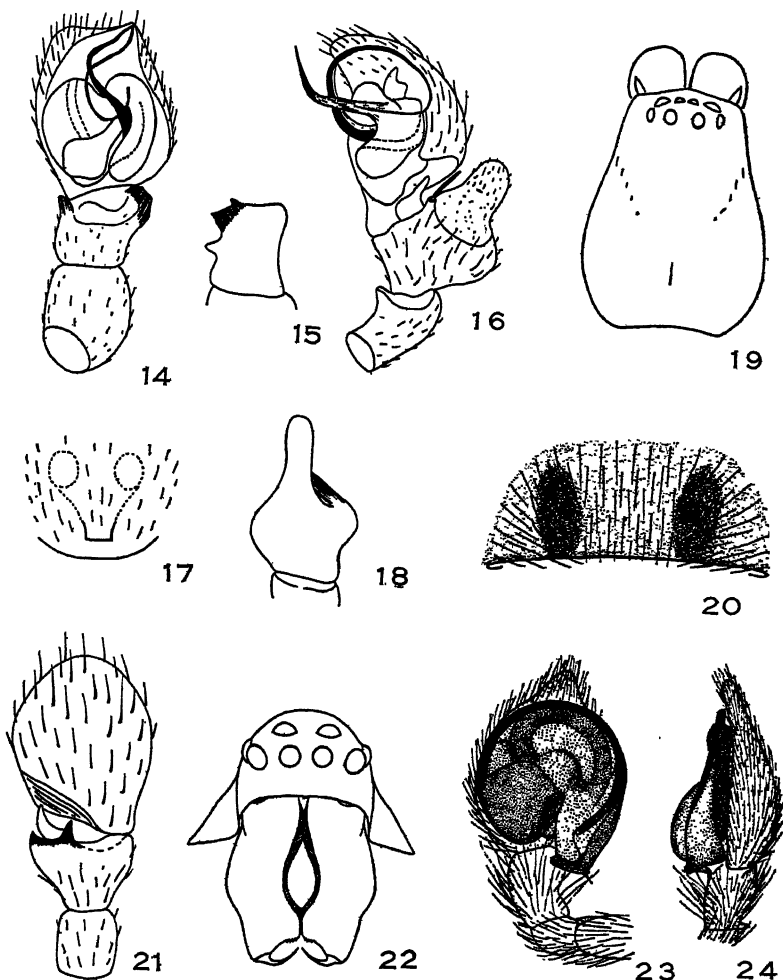
MALE.—Total length, 2.70 mm. Carapace, 1.50 mm. long, 1.10 mm. wide.

Carapace dark reddish brown in color, the eyes narrowly ringed in black, slightly streaked with darker chromatism in the thoracic portion, the whole carapace sparsely clothed with white scaly hairs. Sternum and labium dark brown, the endites and coxae paler brown. Legs light yellowish brown, unmarked except for indications of narrow terminal black annulae on the tibiae and metatarsi. Dorsum of the abdomen with a broad black band made up of a basal triangular maculation and broader chevrons behind; sides of the abdomen dark brown, the venter infuscated.

Carapace longer than broad, the thoracic port orbicular in outline, the pars cephalica considerably elevated, weakly rounded in front, highest behind the ocular region. Median suture weakly distinct but the cephalic striae virtually obsolete. Clypeus sloping, three-fourths as high as the median ocular quadrangle. Eyes of the first row straight, recurved as seen from above, the medians separated by a diameter, half as far from the larger laterals. Eyes of the second row very weakly recurved, the medians separated by their long diameter, slightly farther from the subequal laterals. Median ocular quadrangle broader than long (22/18), slightly narrowed in front, the posterior medians somewhat larger. Chelicerae curved, shallowly excavated on the inner side. Sternum longer than broad (8/7), cordate, truncated in front, weakly rounded on the sides, bluntly pointed between the posterior coxae which are separated by their width. Labium longer than broad (35/27). Tibia and patella of the first leg longer than the carapace (1.60 mm.). Tibia of palpus with a short basal spur on the dorsal aspect.

TYPE LOCALITY.—Male holotype from Minneapolis, Minnesota, June 1, 1931 (W. J. Gertsch).

This species is closely related to *Dictyna phylax*, new species, but the tibia of the palpus is proportionately much broader, the apophysis differs somewhat in size and form, and the conductor of the embolus is distinct as figured.



- Fig. 14. *Ceraticelus anomalus*, new species, palpus, ventral view.  
 Fig. 15. Idem, tibia of palpus, dorsal view.  
 Fig. 16. *Floricomus ornatus*, new species, palpus, subventral view.  
 Fig. 17. Idem, epigynum.  
 Fig. 18. Idem, tibia of palpus, dorsal view.  
 Fig. 19. *Argemina reclusa*, new species, carapace, dorsal view.  
 Fig. 20. Idem, epigynum.  
 Fig. 21. *Ceraticelus desertus*, new species, palpus, dorsal view.  
 Fig. 22. *Dictyna cambridgei*, new species, frontal view of male.  
 Fig. 23. Idem, palpus, ventral view.  
 Fig. 24. Idem, palpus, prolateral view.

*Dictyna cambridgei*, new species

Figures 9, 22 to 24

MALE.—Total length, 1.30 mm. Carapace, 0.75 mm. long, 0.65 mm. wide.

Carapace dark reddish brown, somewhat blackened at the sides of the head and at the position of the striae, clothed with long white hairs. Sternum and mouth parts lighter reddish brown, with a sparse covering of white scales. Legs very pale yellowish brown, without contrasting markings, clothed with pale hairs. Dorsum of abdomen mainly white, reticulate in gray, the venter pale.

Carapace longer than broad, the pars thoracica suborbicular in outline, the pars cephalica very much elevated, convex, highest just behind the ocular area, somewhat rounded in front. Clypeus sloping, three-fourths as high as the median ocular quadrangle. Striae obsolete. Chelicerae curved, moderately excavated on the inner side. Eyes of the first row straight, recurved as seen from above, the medians separated by nearly a radius, half as far from the subequal laterals. Eyes of the second row very slightly recurved, the medians separated by their short diameter, as far from the subequal laterals. Median ocular quadrangle as broad as long, equally wide in front as behind, the eyes subequal. Sternum longer than broad (24/22), truncated in front rather broadly rounded on the sides, truncated between the posterior coxae which are separated by their width. Labium longer than broad (17/16). Tibia and patella of the first leg longer than the carapace (0.82 mm.). Tibia of palpus with a short spur near the base on the dorsal side. Details of palpus as figured.

FEMALE.—Total length, 1.85 mm. Carapace, 0.80 mm. long, 0.65 mm. wide.

Color essentially as in the male but the abdomen with a round black spot near the base of the dorsum and a pair of spots near the caudal end. Sternum narrowly ringed in black. Carapace strongly convex but the pars cephalica much less conspicuously elevated than in the male, as usual. Median eyes of the first row separated by nearly their diameter, scarcely a radius from the subequal laterals. Median eyes of the second row separated by one and one-third times their diameter, as far from the subequal laterals. Median ocular quadrangle broader than long (15/13), very slightly narrowed in front. Tibia and patella of the first leg shorter than the carapace (0.74 mm.). Epigynum as figured.

TYPE LOCALITY.—Male holotype and female allotype from Tonala, Chiapas, Mexico, August, 1909 (A. Petrunkevitch).

This tiny species suggests *Dictyna cruciata* Emerton but differs in having the abdomen of the female distinctly spotted above and in the details of the genitalia.

*Dictyna formidolosa*, new name

*Dictyna armata* BANKS, 1911, Proc. Acad. Nat. Sci. Philadelphia, p. 444, Pl. XXXIV, fig. 9. (Not *Dictyna armata* Thorell, 1875.)

RECORD.—Newman's Lake, Gainesville, Florida, June, 1935, numerous males and females taken by sifting (W. Ivie and W. J. Gertsch).

*Dictyna voluta*, new species

Figure 28

MALE.—Total length, 3.10 mm. Carapace, 1.52 mm. long, 1.20 mm. wide.

Carapace uniform dark reddish brown in color, clothed sparsely with long white scaly hairs. Sternum and mouth parts dark reddish brown, the coxae paler, the underside rather thickly covered with white hairs. Legs light reddish brown throughout, clothed with inconspicuous pale hairs. Abdomen mainly light brown, the dorsum with a long black maculation at the base which is followed by dark chevrons, the venter brown, the whole abdomen evenly covered with white hairs.

Carapace robust, longer than broad, the head portion well elevated, convex, very broad, highest behind the ocular region, weakly rounded in front. Sutures practically obsolete. Clypeus sloping, as high as the median ocular quadrangle. Chelicerae strongly bent, with a weakly developed basal horn, excavated on the inner side. Eyes of the first row straight from in front, recurved as viewed from above, the medians separated by one and one-half times their diameter, practically a diameter from the somewhat larger laterals. Eyes of the second row very slightly recurved, the medians separated by one and one-half times their diameter, as far from the slightly larger laterals. Median ocular quadrangle broader than long (23/18), slightly narrowed in front (23/21), the eyes subequal. Sternum longer than broad (80/73), cordate, truncated in front, bluntly pointed between the posterior coxae which are separated by their width. Labium longer than broad (35/31). Tibia and patella of the first leg longer than the carapace (1.60 mm.). Tibia of the palpus with a short stout apophysis near the base on the dorsal aspect. Terminal part of the conductor of the embolus strongly revolved for two turns.

FEMALE.—Total length, 3.60 mm. Carapace, 1.20 mm. long, 1.00 mm. wide.

Color and structure essentially as in the male, with allowances for sexual differences. Abdomen mainly pale above, with the pattern of the male very poorly indicated. Carapace not so highly elevated and the chelicerae normal. Tibia and patella of the first leg as long as the carapace (1.20 mm.). Eyes as in the male.

TYPE LOCALITY.—Male holotype, female allotype and two female paratypes from Electra Lake, Colorado, July 1, 1919 (F. E. Lutz).

This large species resembles *Dictyna volucripes* Keyserling in superficial characters but the palpi are quite distinct. In *voluta* the tibial spur of the male palpus is very short and the terminal part of the conductor is revolved, not twisted and truncated at the end.

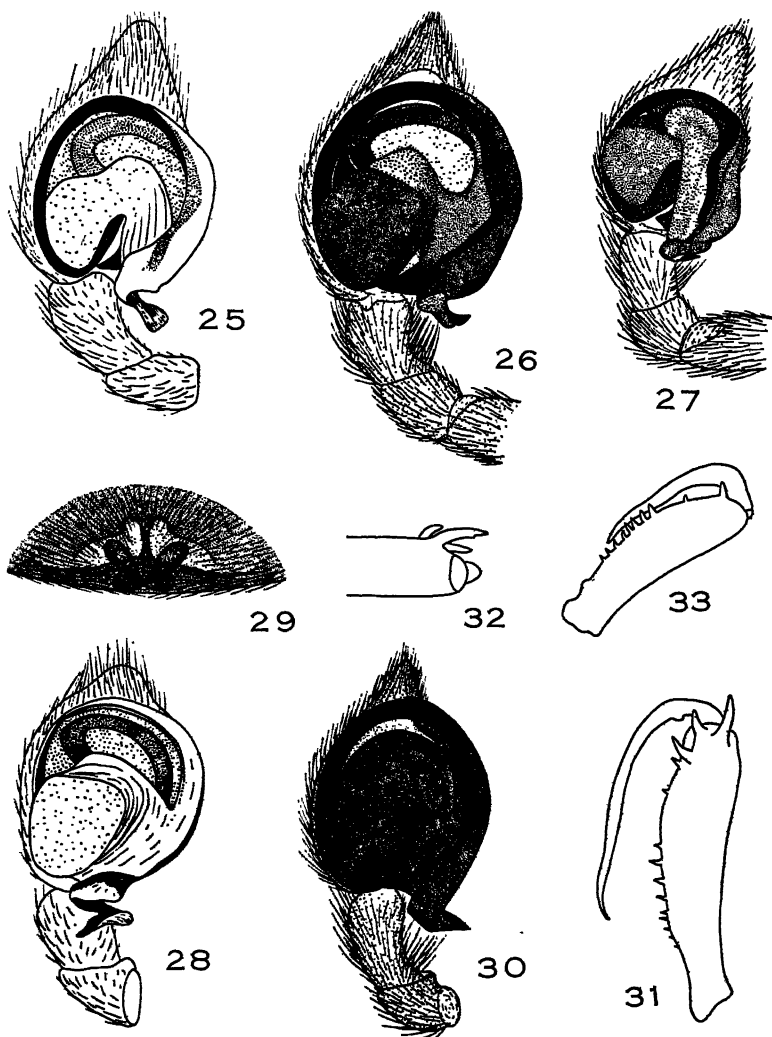
#### *Dictyna semota*, new species

Figure 25

MALE.—Total length, 2.95 mm. Carapace, 1.36 mm. long, 1.00 mm. wide.

Carapace light yellowish brown, darker in the thoracic portion where there are faint dark streaks and markings, clothed sparsely with pale hairs. Sternum and mouth parts light brown, sparsely clothed with black hairs. Coxae and legs very pale yellowish brown, covered with pale hairs. Abdomen yellowish brown, with a large triangular dark maculation near the base above which is continuous with a row of broader dark chevrons that run back the length of the dorsum. Sides of the abdomen mottled in black, the venter somewhat infuscated.

Carapace longer than broad, the convex thoracic portion a broad oval in outline, the cephalic portion much elevated, weakly rounded in front and on the sides, highest behind the eye group. Clypeus sloping, as high as the median ocular quadrangle.



- Fig. 25. *Dictyna semota*, new species, palpus, ventral view.  
 Fig. 26. *Dictyna vigilans*, new species, palpus, ventral view.  
 Fig. 27. *Dictyna reticulata*, new species, palpus, ventral view.  
 Fig. 28. *Dictyna voluta*, new species, palpus, ventral view.  
 Fig. 29. *Dictyna phylax*, new species, epigynum.  
 Fig. 30. *Idem*, palpus, ventral view.  
 Fig. 31. *Tetragnatha steckleri*, new species, right chelicera of male, dorsal view.  
 Fig. 32. *Idem*, terminal portion of right chelicera of male, prolateral view.  
 Fig. 33. *Idem*, right chelicera of female, dorsal view.

Eyes of the first row straight from in front, recurved as seen from above, the medians separated by fully their diameter, half as far from the larger lateral eyes. Eyes of the second row straight, the medians separated by one and one-half times their diameter, as far from the subequal laterals. Median ocular quadrangle broader than long (20/17), the eyes subequal in size. Chelicerae very strongly curved, moderately excavated on the inner side. Sternum longer than broad (70/62), truncated in front, broadly rounded on the sides, bluntly rounded between the posterior coxae which are separated by their width. Labium longer than broad (30/25). Tibia and patella of the first leg longer than the carapace (1.40 mm.). Tibia of the male palpus with a short apophysis at the base on the dorsal aspect. Details of palpus as figured.

**TYPE LOCALITY.**—Male holotype from Waterloo, Wisconsin, August 1–10, 1934 (K. B. Humphrey). Male paratype from Washington, D. C., June.

This species is closely related to *Dictyna vigilans* but the details of the palpus are slightly different, the terminal portion of the conductor being twisted and truncated.

#### *Dictyna brevitarsus* Emerton

*Dictyna brevitarsus* EMERTON, 1915, Trans. Connecticut Acad. Arts and Sci., XX, p. 140, with figures.

**RECORDS.**—Bloomington, Idaho, August 10, 1931, male (W. J. Gertsch). East Lansing, Michigan, June 2, 1921, male (W. M. Barrows). Ramsey, New Jersey, June 9, 1934, male (W. J. Gertsch).

#### *Dictyna minuta* Emerton

*Dictyna minuta* EMERTON, 1888, Trans. Connecticut Acad. Arts and Sci., VII, p. 447, Pl. IX, figs. 5 and 5a.

**RECORDS.**—Lake Minnetonka, Minnesota, June 4, 1932, male (W. J. Gertsch). Salt Lake City, Utah, September, 1930, male (W. J. Gertsch).

#### *Dictyna bicornis* Emerton

*Dictyna bicornis* EMERTON, 1915, Trans. Connecticut Acad. Arts and Sci., XX, p. 141, with figures.

**RECORDS.**—Stillwater, Minnesota, May 6, 1933, male (C. E. Mickel). Minneapolis, Minnesota, June 1, 1931, male, females (W. J. Gertsch). Lake Pepin, Minnesota, April 25, 1931, male (W. J. Gertsch).

### Micryphantidae

#### *Floricomus ornatulus*, new species

Figures 16 to 18

**MALE.**—Total length, 1.50 mm. Carapace, 0.73 mm. long, 0.61 mm. wide.

Carapace light brown, the cephalic portion darker, the margins and the striae infuscated, the eyes ringed with black. Sternum and labium darker brown, the endites lighter brown. Legs yellowish to reddish brown. Dorsum of abdomen covered



with a sclerotized, bright red plate which is evenly clothed with large appressed hairs.

Carapace broader than long, broadly and evenly rounded, the cephalic sutures feebly represented, the median furrow a slight depression. Clypeus produced into a horn as in *rostratus* Emerton which is armed with capitate hairs. Clypeus vertical, nearly as high as the chelicera. Eyes of the anterior row procurved, recurved as seen from above, the medians separated by two-thirds their diameter, as far from the somewhat larger laterals. Second row of eyes very weakly procurved, virtually straight, the medians separated by two-thirds their diameter, slightly farther from the subequal laterals. Median ocular quadrangle slightly longer than broad, equally wide in front as behind. Sternum about as long as broad, truncated between the posterior coxae which are separated by their width. Palpus as figured.

FEMALE.—Total length, 3.20 mm. Color as in the male. Structure as in the male but the head normal. Epigynum as figured.

TYPE LOCALITY.—Male holotype, female allotype and two female paratypes from Edinburg, Texas, January 10–20, 1935 (S. Mulaik). Female paratype from seven miles east of Edinburg, February 8, 1935 (S. Mulaik). Male and female paratypes from five miles south of San Juan, Texas, February 22, 1935 (S. Mulaik). Female paratype from southwest of Harlingen, Texas, November 18, 1934 (S. Mulaik).

This species resembles *Floricomus rostratus* (Emerton) in general appearance but is distinct in the palpus and in the eye arrangement. The eyes of the first row are subequidistant in *ornatulus* but the medians are much farther from the laterals than from each other in *rostratus*. The tibial apophysis is quite different from any other species of the genus.

### *Ceraticelus anomalus*, new species

Figures 14 and 15

MALE.—Total length, 1.60 mm. Carapace, 0.70 mm. long, 0.57 mm. wide.

Carapace dark reddish brown, the head dusky, the eyes narrowly ringed in black, without conspicuous hairs or spines. Sternum yellowish orange, the margins darker, sparsely clothed with short erect black hairs. Labium brown, the endites concolorous with the sternum. Legs yellow to pale yellowish brown, sparsely clothed with black hairs. Basal joints of the palpus dusky, the tibia and tarsus dark brown. Dorsum of abdomen with the usual sclerotized yellowish orange plate which covers all of the dorsum but the caudal extremity, and is supplied throughout with short procumbent hairs. Epigastric plate concolorous with the dorsal scutum and the broad inframammary plate, the venter supplied with hairs of the same type as the dorsum.

Structure of carapace somewhat as in *Ceraticelus similis* (Banks), the head moderately enlarged and slightly protruding over the clypeal margin. Integument of the pars thoracica evenly and faintly reticulate. Eyes of the first row recurved, the medians subcontiguous, separated from the subequal laterals by twice the diameter of a median. Clypeus two and one-half times as high as the diameter of an anterior median eye. Eyes of the second row very weakly procurved, the medians

separated by one and one-half times their diameter, somewhat nearer the subequal laterals. Median ocular quadrangle as long as broad, much narrowed in front (20/10), the eyes subequal. Sternum broader than long (35/32), the caudal truncature separating the coxae by their length. Abdomen seven-ninths as broad as long, moderately convex. Palpus as figured.

**TYPE LOCALITY.**—Male holotype from seven miles east of Edinburg, Texas, February 17, 1935 (S. Mulaik).

The palpus of this species is suggestive of that of *Ceraticelus laticeps* (Emerton) but the whole appendage is comparatively shorter, the patella being thickened and about two-thirds as long as the femur.

***Ceraticelus desertus*, new species**

Figure 21

**MALE.**—Total length, 1.20 mm. Carapace, 0.62 mm. long, 0.50 mm. wide.

Carapace dark orange brown, the eyes ringed in black and enclosing a black area, the integument finely reticulate, particularly evident on the pars thoracica. Sternum orange brown, finely roughened, the margins darker, clothed sparsely with short hairs. Labium orange brown, the endites paler. Legs pale yellowish brown, clothed with black hairs. Dorsum of abdomen covered with a strongly sclerotized orange plate which is clothed with short procumbent black hairs. Epigastric plate yellowish orange, the posterior lateral angles coalescent and broadly enclosing the genital furrow. Inframammary plate yellowish orange, extensive below, more narrowly enclosing the spinnerets above.

Carapace somewhat longer than broad, convex, the head portion normal, the sutures obsolete. Eyes of the first row in a very weakly recurved line, the medians separated by scarcely a radius, not much farther from the slightly larger laterals. Eyes of the second row straight, the medians separated by a diameter, as far from the subequal lateral eyes. Median ocular quadrangle as broad as long, narrowed in front (10/14), the anterior medians smaller. Lateral eyes subcontiguous. Clypeus twice as high as the diameter of an anterior median eye. Sternum as broad as long, truncated behind, the posterior coxae separated by more than their length. Details of the palpus essentially as in *Ceraticelus minutus* (Emerton) but the tibial apophysis distinct as figured.

**TYPE LOCALITY.**—Male holotype and two male paratypes from Edinburg, Texas, November 27, 1935 (S. Mulaik).

This tiny species agrees with *Ceraticelus micropalpus* (Emerton) and *C. minutus* (Emerton) in having the head normal and the posterior lateral angles of the epigastric sclerite coalescent behind, enclosing the genital furrow. It is distinct from each of these in the details of the tibial apophysis.

**Linyphiidae**

***Labulla alticulata* Keyserling**

Figures 40 and 41

*Labulla alticulata* KEYSERLING, 1886, 'Die Spinnen Amerikas,' Theridiidae, II, p. 94, Pl. XIV, fig. 186.

RECORDS.—Oregon: Portland, February, 1934, female (J. M. Pierson). Sandy, July 1–5, 1932, female (J. M. Pierson). Eight miles southeast of Colton, April–May, 1934, males and females (J. M. Pierson). McMinnville, two females (R. W. Macy). Corvallis, March 1, 1935, female; May 4, 1935, female; March 24, 1935, two females (J. M. Pierson). Corvallis, February 20, 1935, male (S. Jewett, Jr.). Corvallis, March 4, 1935, female (J. Schuh). Oak Creek, Corvallis, April 11, 1935, female (J. M. Pierson). Alsea, May 5, 1935, female (J. M. Pierson). Ashland, August 30, 1931, females (Wilton Ivie).

*Labulla utahana*, new species

Figure 39

FEMALE.—Total length, 4.80 mm. Carapace, 2.00 mm. long, 1.60 mm. wide.

Carapace yellowish brown above, the margins infuscated, with a triangular black marking in front of the median furrow, the eyes ringed in black. Carapace with a sparse clothing of inconspicuous pale hairs and a few weak black spines. Sternum dark brown, the mouth parts concolorous but paler distally. Legs yellow to orange brown, feebly annulate in brown, clothed with pale hairs and weak spines. Abdomen gray above, with a black median longitudinal maculation which is narrow at the base but widened decidedly caudally, the posterior portion broken up into chevrons. Sides of the abdomen mainly black, the venter pale.

Carapace longer than broad, moderately convex, equal in height for most of the length, the median suture a deep subcircular groove, the cephalic striae weakly indicated. Pars cephalica rounded in front, weakly convex above, the width at the second eye row about half the greatest width of the carapace. Eyes of the first row weakly recurved from in front, more strongly recurved as seen from above, the medians separated by about their radius, as far from the subequal laterals. Clypeus equal in height to about one and one-half times the diameter of an anterior median eye. Eyes of the second row weakly recurved, the medians separated by scarcely a diameter, as far from the subequal laterals. Median ocular quadrangle as broad as long, equally wide in front as behind, the eyes subequal. Lateral eyes of each side subcontiguous. Sternum slightly longer than broad (55/53), broadly truncated in front, narrowly truncated between the posterior coxae which are separated by scarcely their width. Labium broader than long (37/25), subquadrangular in outline, scarcely half as high as the endites. Chelicerae with three teeth on the upper margin, two of which are very large and two small teeth on the lower margin. Legs moderately long, the first tibia with four prolateral and retrolateral spines and with five pairs of ventral spines, the last pair not apical in position. First leg: femur, 3.10 mm., patella, 0.75 mm., tibia, 3.10 mm., metatarsus, 3.00 mm., and tarsus, 1.60 mm. long.

TYPE LOCALITY.—Female holotype from Salt Lake City, Utah, September, 1930 (W. J. Gertsch).

*Labulla hespera*, new species

Figures 34 to 36

MALE.—Total length, 6.30 mm. Carapace, 3.00 mm. long, 2.65 mm. wide. Carapace sparsely clothed with fine black hairs, the ocular area with longer ones.

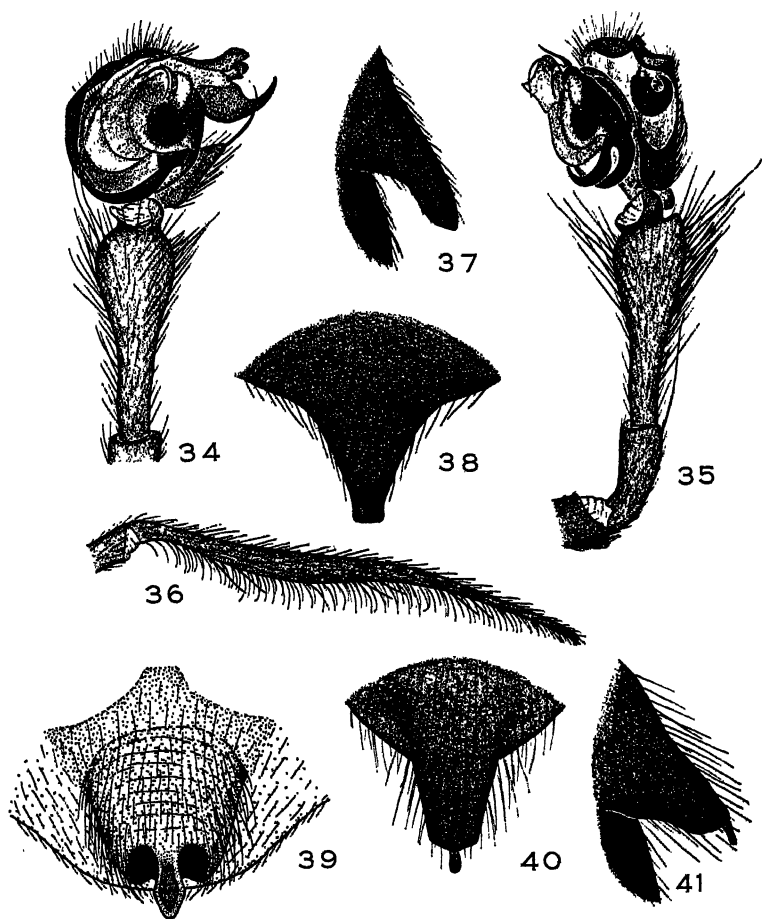


Fig. 34. *Labulla hespera*, new species, palp, ventral view.

Fig. 35. Idem, palp, prolateral view.

Fig. 36. Idem, first metatarsus of male, lateral view.

Fig. 37. *Labulla jellisoni*, new species, epigynum, lateral view.

Fig. 38. Idem, epigynum, ventral view.

Fig. 39. *Labulla utahana*, new species, epigynum, ventral view.

Fig. 40. *Labulla altiocularata* Keyserling, epigynum, ventral view.

Fig. 41. Idem, epigynum, lateral view.

Carapace pale yellowish brown, the margins infuscated, the pars cephalica with a dark maculation just in front of the median suture, the eyes ringed in black. Sternum dusky, with a narrow marginal black seam, clothed with black hairs. Labium and endites dusky, distally paler, clothed sparsely with black hairs. Legs light yellowish brown, without annulae, clothed with fine black hairs and longer spines. Dorsum of abdomen mainly black, with yellow chevrons which are broken up into spots caudally, the venter pale, with a median brown maculation. Spinnerets pale yellow.

Carapace longer than broad, moderately high, convex, the median suture and cephalic striae deeply grooved. Clypeus as high as the diameter of an anterior median eye. First row of eyes weakly recurved, more strongly recurved as viewed from above, the medians separated by three-fifths their diameter, as far from the subequal laterals. Eyes of the second row very weakly recurved, the medians separated by about three-fifths their diameter (10/16), scarcely a diameter from the subequal laterals (14/16). Lateral eyes subcontiguous, on slightly elevated tubercles. Median ocular quadrangle broader than long (44/40), slightly narrowed in front (44/38), the eyes subequal in size. Sternum broader than long (85/75). Labium broader than long (45/40), about half as high as the parallel endites. Chelicera with three teeth on the upper margin, two large and one much smaller, the lower margin with two small teeth. First leg: femur, 7.30 mm., patella, 1.30 mm., tibia, 7.40 mm., metatarsus, 8.50 mm., and tarsus, 3.30 mm. long. First metatarsi sinuous, moderately incrassated in the basal half, the details of the hairs and spines as figured. First tibiae with four prolateral, four retrolateral and four pairs of ventral spines, the last pair not apical. Palpus elongate, the measurements as follows: Femur, 3.00 mm., patella, 0.80 mm., tibia, 1.40 mm., and tarsus, 1.10 mm. long. Tibia of palpus expanded distally. Details of palpus as figured.

TYPE LOCALITY.—Male holotype and immature male paratype from Aspen Valley, Yosemite National Park, California, August 12, 1931 (W. Ivie), in the collection of the University of Utah.

The single known adult male of this species presents numerous characters which differentiate it from *Labulla altiocolata* Keyserling. The first leg in Keyserling's species is elongate but normal in form and the femur is armed with a conspicuous series of stout ventral spines. In *hespera* the femur is normal and without a conspicuous spinal armature but the metatarsus is greatly elongated, somewhat sinuous and moderately incrassated in the basal half. The palpi of the two species have much in common, particularly in the structure and details of the bulb and the apophyses, but the palpal joints in *hespera* are very much longer, the tibia being about one and one-half times as long as the tarsus and the femur three times as long. In *altiocolata* the tibia and patella together are scarcely as long as the tarsus.

*Labulla jellisoni*, new species

Figures 37 and 38

FEMALE.—Total length, 8.50 mm. Carapace, 3.50 mm. long, 2.50 mm. wide. Carapace sparsely clothed with fine black hairs, light yellowish brown in color,

the margins and the cephalic striae infuscated. Sternum and labium light brown, clothed with black hairs, the endites reddish brown. Legs bright reddish brown, without annulae, clothed with black hairs and spines. Abdomen mainly black, the dorsum with broken white chevrons, the venter paler, with a white line on each side.

Carapace longer than broad, moderately high and convex, the sutures deep grooves. Pars cephalica highest just behind the eyes, convex, the width at the second eye row scarcely half the greatest width of the carapace. Clypeus about equal in height to the height of the median ocular quadrangle. Eyes of the first row very weakly recurved, virtually straight, the medians separated by a radius, slightly farther from the subequal lateral eyes. Eyes of the second row very weakly recurved, the medians separated by two-thirds their diameter, slightly farther from the subequal laterals. Median ocular quadrangle about as long as broad, slightly narrowed in front, the eyes subequal. Structure of the sternum, labium, and the armature of the chelicerae as in the other species. First leg: femur, 6.55 mm., patella, 1.35 mm., tibia, 7.35 mm., metatarsus, 7.35 mm., and tarsus, 2.75 mm. long. Legs normal, elongated, the first tibiae with five prolateral, five retrolateral, and five pairs of ventral spines, the last pair of which is not apical. Epigynum lacking the small terminal spur which is present in *Labulla altioculata* and *ulahana*.

TYPE LOCALITY.—Female holotype from Blodgett Canyon, Montana, April 21, 1933 (W. L. Jellison). Female paratype from West Fork, Ravalli County, Montana, March 11, 1934 (W. L. Jellison).

### Argiopidae

#### *Tetragnatha steckleri*, new species

Figures 31 to 33

MALE.—Total length, 9.40 mm., not including the chelicerae. Carapace, 3.80 mm. long, 2.25 mm. wide.

Carapace bright yellowish brown, the striae darkened, the eyes narrowly ringed with black. Sternum, coxae and endites concolorous with the dorsum, the labium dark brown. Chelicerae yellowish brown, the teeth and the claw black. Legs a little duller than the carapace, unmarked, clothed with fine black hairs and very weak spines. Carapace very sparsely clothed with short black hairs.

Carapace much longer than broad, weakly rounded in front and on the sides, the caudal end emarginated above the pedicel. Pars cephalica higher than the pars thoracica, two-thirds as broad at the eyes as at the broadest point (27/43), which is between the second coxae. Sutures, particularly the median groove, well defined. Pars thoracica weakly convex, subquadrangular in outline. Eyes of the first row recurved from above, straight as seen from in front, the medians less than a diameter apart (13/18), nearly two diameters from the much smaller laterals (18/34). Eyes of the second row recurved, the medians separated by scarcely two diameters (13/23), fully two diameters from the subequal laterals (13/29). Lateral eyes of each side separated from each other by their diameter. Median ocular quadrangle broader than long (50/45), narrowed in front, the anterior eyes larger, separated from the posterior medians by their diameter. Sternum three-fifths as broad as long, subtriangular, truncated in front and with a short hook at each side

of the labium. Labium slightly broader than long, rounded at the end, scarcely half as high as the subparallel, subquadrangular endites. First leg with short spines that are at most no more than twice the width of the narrow joints, the measurements of the first leg as follows: femur, 9.30 mm., patella, 1.40 mm., tibia, 9.70 mm., metatarsus, 9.50 mm., and tarsus, 1.90 mm. long. Chelicera longer than the carapace (45/35), the dorsum with a stout spur near the distal end which has a weak tooth beneath the apex, two stout spurs near it on the inner side which are followed by two teeth, an interval, and then by a series of ten teeth that go back three-fourths of the total length of the chelicera. Lower margin with an even series of teeth (14) that begins at the apex and goes back two-thirds of the length of the chelicera, becoming progressively smaller caudad. Cymbium of palpus normal, the paracymbium bluntly pointed at the end. Tibia of palpus longer than the patella (25/20). Abdomen nearly three times as long as broad.

FEMALE.—Total length, 8.50 mm. Carapace, 3.00 mm. long, 2.00 mm. wide. Basal joint of the chelicera as long as the carapace. Structure essentially as in the male, the abdomen shorter, more than twice as long as broad (12/5).

TYPE LOCALITY.—Male holotype and female allotype from Tucson, Arizona, July–August, 1935 (Peter Steckler).

This species is closely related to *Tetragnatha antillana* Simon and *T. seminola* Gertsch and agrees rather well in the disposition of the teeth at the end of the chelicera, the principal spur being subterminal in position and not furcated. It may be separated by the details of these denticles as illustrated in the figures.

#### *Meta menardi* (Latreille)

*Aranea menardi* LATREILLE, 1804, 'Hist. Nat. Crust. et Ins.,' VII, p. 266.

*Auchicybaeus ovalis* GERTSCH, 1933, American Museum Novitates, No. 637, p. 11.

The type of *Auchicybaeus ovalis* Gertsch is a much crushed and mutilated example of *Meta menardi* (Latreille).

#### *Meta curtisi* (McCook)

*Pachygnatha cyrtisi* McCook, 1893, 'American Spiders,' III, p. 271, Pl. xxvi, fig. 5.

This species, which is widely distributed and a common species on the Pacific Coast, is virtually identical with *Meta segmentata* of Europe. The name will possibly be retained as a varietal one.

#### *Metopeira foxi*, new species

Figures 42 to 44

FEMALE.—Total length, 6.00 mm. Carapace, 2.15 mm. long, 1.17 mm. wide.

Carapace pale to dark brown or reddish brown, the cephalic portion often pale yellow, the thoracic portion darker on the sides, somewhat streaked in the position of the striae. Clothing of carapace, long white hairs that are less conspicuous on the pars cephalica. Eyes narrowly ringed in black. Chelicerae pale yellow, brown on the sides and at the distal end. Sternum black, the labium and endites black but with

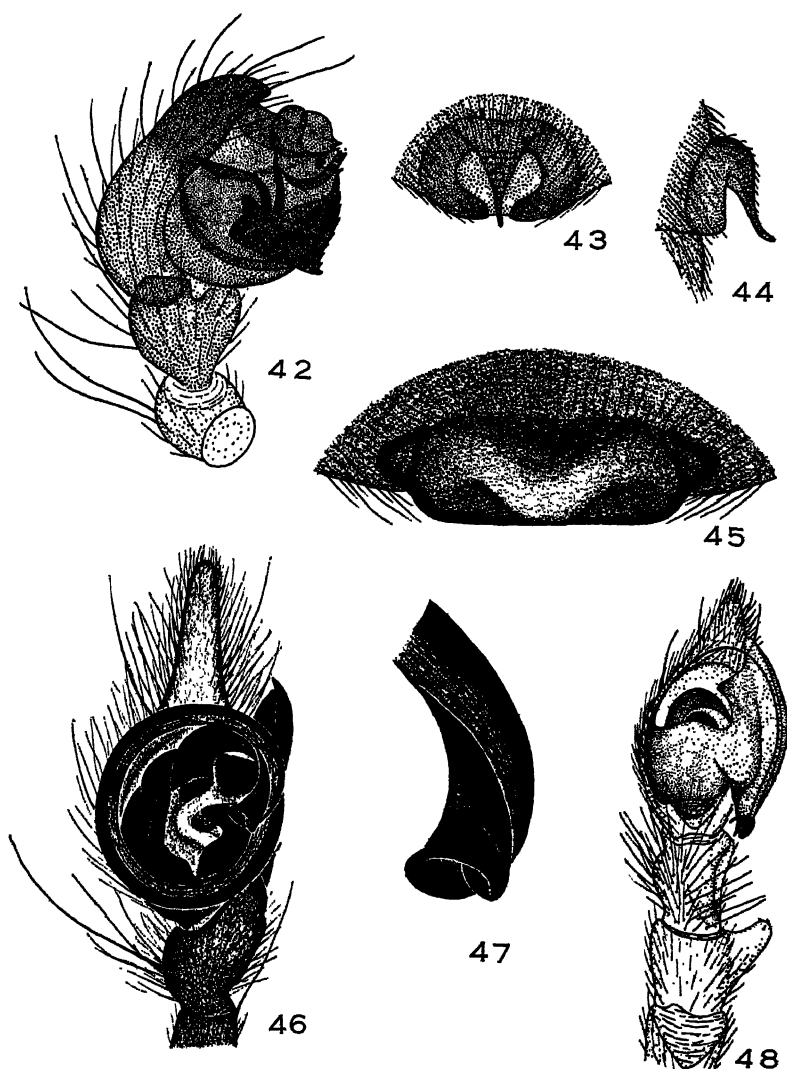


Fig. 42. *Metepeira forzi*, new species, palp, lateral view.

Fig. 43. Idem, epigynum, ventral view.

Fig. 44. Idem, epigynum, lateral view.

Fig. 45. *Agelena approximata*, new species, epigynum, ventral view.

Fig. 46. *Agelena actiuosa*, new species, palp, ventral view.

Fig. 47. Idem, tip of embolus of palp.

Fig. 48. *Cybaeus consocius* Chamberlin and Ivie, palp, ventral view.



their distal margins brown. Coxae yellow, the trochanters usually brown. Legs yellow to light brown, the femora with a distal, the patellae a medial, the tibiae with basal and distal, and the metatarsi and tarsi with narrow distal annulae. Dorsum of abdomen mainly gray to white, the dentate median folium margined in black. Venter with a broad black band which encloses a creamy-white median longitudinal stripe and a spot at each side of the spinnerets, which are black.

Carapace longer than broad, moderately convex, about equal in height for most of the length, the median suture a slight depression, the striae weakly indicated. Pars cephalica slightly rounded in front, convex. Eyes of the first row slightly recurved as seen from in front, more strongly so as viewed from above, the medians separated by one and one-fourth times their diameter, one and two-thirds their diameter from the subequal laterals. Eyes of the second row recurved, the medians separated by three-fourths their diameter, slightly more than two diameters from the subequal laterals. Median ocular quadrangle as broad as long, broader in front than behind (36/30), the anterior medians slightly larger. Clypeus equal in height to one-half the diameter of an anterior median eye. Sternum longer than broad (20/19), cordate, weakly emarginated in front, somewhat rounded on the sides, bluntly pointed between the posterior coxae which are scarcely separated. Labium broader than long (40/31). Chelicera armed with three teeth on each margin of the furrow. First tibiae armed with four pairs of ventral spines, the metatarsi with three pairs, the last not distal. Epigynum as figured.

MALE.—Total length, 3.50 mm. Color and general structure essentially as in the female. Legs decidedly longer, the second femora with numerous long erect spines on the lower side. Male palpus as figured.

TYPE LOCALITY.—Male holotype and female allotype from Richfield, Utah, July and August, 1930 (W. J. Gertsch). Male and female paratypes from Fish Lake, Sevier County, Utah, August 4, 1930 (W. J. Gertsch). Male and female paratypes from Medicine Hat, Alberta, Canada, June, 1930.

### Agelenidae

#### *Cybaeus consocius* Chamberlin and Ivie

Figure 48

*Cybaeus consocius* CHAMBERLIN AND IVIE, 1932, Bull. Univ. Utah, XXIII (No. 2), p. 25, Pl. VI, fig. 61.

A figure of the palpus of the male of this species, which was described from a damaged female, is given.

#### *Agelena actiosa*, new species

Figures 46 and 47

MALE.—Total length, 8.30 mm. Carapace, 4.20 mm. long, 3.00 mm. wide. Coloration as in other species of the *naevia* group.

Eyes of the first row strongly procurved, subequal, separated by about a radius. Eyes of the second row strongly procurved, subequal, the medians separated by fully their diameter, farther from the laterals. Median ocular quadrangle slightly broader

behind, much broader than long, the eyes subequal. Clypeus as high as one and one-half times the diameter of an anterior median eye. Chelicera with three subequal teeth on the lower and the upper margins. Spines under the tibiae and metatarsi 2-2-2. Tibia and patella I scarcely as long as tibia and patella IV, slightly longer than the carapace (4.60 mm./4.20 mm.). Distal joint of the hind spinnerets twice as long as the basal. Palpus of the *naevia* type. Conductor a heavy black spur twice as long as broad, bluntly pointed at the end. Embolus a very heavy tube, making one and one-half turns, the distal end revolute. Other details as in the figures.

**TYPE LOCALITY.**—Male holotype from Cape Mearns, Tillamook County, Oregon, August 22, 1931 (R. W. Macy). Male paratype from Corvallis, Oregon, August 16, 1934 (J. Schuh). Two male paratypes from St. Thomas, Ontario, fall, 1929 (Lorne E. James).

***Agelena singula*, new species**

Figures 49 and 50

**MALE.**—Total length, 7.50 mm. Carapace, 3.70 mm. long, 2.55 mm. wide.

Carapace with a broad yellowish band along the margin on each side which extends from the clypeus to the base. Rest of the head light brownish, with the median interocular area and the middle of the clypeus in front light yellowish. The remainder of the thoracic portion still darker brown, with the radial streaks more intense; this brown area narrowly cleft behind by a short median streak of yellow. Chelicerae light chestnut, the distal part light yellow. Endites, labium and sternum dull yellow, the sternum with indistinct dusky markings and shadings. Legs yellowish, with faint annulae, the only ones that are at all distinct being at the distal end of the metatarsi. Abdomen of the typical pattern, being dusky brown, with two longitudinal light lines separating off a broad central band on the basal half, this band being dark at the base and becoming lighter posteriorly where it is crossed by four light chevrons. Venter pale yellowish gray, speckled with dark brown, some of the markings forming two widely separated parallel lines which extend from the epigastric furrow back to near the spinnerets and then converge sharply to a point just in front of the spinnerets.

Structure essentially typical for the genus. Legs longer and more slender than usual but most peculiar in that leg I is longer than leg IV. The hind spinnerets have the apical segment slightly longer than the basal. Tibia and patella I, 6.30 mm., IV, 5.80 mm. long. This species is apparently closely related to *Agelena transversa* (F. Cambridge) but has no close nearctic relatives.

**TYPE LOCALITY.**—Male holotype from Cordova, Mexico.

***Agelena approximata*, new species**

Figures 45, 51, and 52

**FEMALE.**—Total length, 10.50 mm. Carapace, 5.00 mm. long, 3.20 mm. wide.

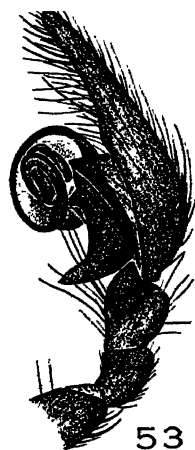
This species is closely related to *Agelena intermedia* Chamberlin and Gertsch, with which species it agrees rather closely in color and structure. The color is of the same pattern as that of *intermedia*, though the abdomen is somewhat lighter. The hind spinnerets have the apical segment about the same length as the basal. The palpus and epigynum are distinctive as shown by the figures. Tibia and patella I, 3.80 mm., IV, 4.40 mm. in the female.



49



51



53



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- Fig. 49. *Agelena singula*, new species, palpus, prolateral view.  
Fig. 50. Idem, palpus ventral view.  
Fig. 51. *Agelena approximata*, new species, palpus, prolateral view.  
Fig. 52. Idem, palpus, ventral view.  
Fig. 53. *Agelena confusa*, new species, palpus, prolateral view.  
Fig. 54. Idem, palpus, ventral view.

MALE.—Total length, 7.10 mm. Carapace, 3.80 mm. long, 2.40 mm. wide. Tibia and patella I, 3.40 mm., IV, 3.90 mm. long.

TYPE LOCALITY.—Male holotype and female allotype from San Jose, Costa Rica.

*Agelena confusa*, new species

Figures 53 and 54

MALE.—Total length, 6.50 mm. Carapace, 3.10 mm. long, 2.10 mm. wide.

Carapace with a broad band of dull yellow along each side of the thoracic part and a broad median band of similar color extending from the eyes to the base. Median band interrupted on the back of the cephalic part by a thick V-shaped mark of pale yellow. Light bands separated by two dusky brown bands of similar width, which extend along the sides of the head back to the base of the carapace. Chelicerae light chestnut, becoming paler distally. Labium dusky brown. Endites light yellowish. Sternum light yellow, shaded with dusky, except along the median line where the duskiness is absent. Legs light reddish brown, except coxae and fourth tarsi which are more yellowish. Abdomen in general light grayish brown above. A median brownish stripe, with a light yellowish stripe on each side, extends along the dorsum, the yellow stripes breaking up into spots posteriorly. Venter pale yellow.

Structure essentially typical, the legs rather long, the apical segment of the hind spinnerets slightly longer than the basal and the anterior median eyes decidedly smaller than the others. The palpus is of a distinct type as figured. Tibia and patella I, 3.80 mm., IV, 4.30 mm. long.

TYPE LOCALITY.—Male holotype from San Jose, Costa Rica.

This species apparently has no close, known relatives though it may be related to one of the species described by F. Cambridge from Central America and based on the female alone.



### **Erratum**

Detach and paste over date of publication on American Museum  
Novitates, No. 841, p. 1:

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: April 11, 1936  
:



# AMERICAN MUSEUM NOVITATES

Number 859

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

June 8, 1936

## AMYNODON MONGOLIENSIS FROM THE UPPER EOCENE OF MONGOLIA<sup>1</sup>

BY HENRY FAIRFIELD OSBORN<sup>2</sup>

The skeleton of an amynodont rhinoceros, essentially complete except for the left fore leg, was one of the choice finds of the 1923 field season in Mongolia. It was collected in the Shara Murun Formation at Ula Usu, by A. F. Johnson, in June and September, 1923, and has been skillfully mounted by Peter Kaisen. It is clearly referable to the genus *Amynodon*, and the closest resemblances are with *Amynodon intermedius* Osborn from the Uinta of Utah.

### *Amynodon mongoliensis*, new species

TYPE.—Amer. Mus. No. 20278, a laterally crushed skull and nearly complete skeleton, lacking the left fore leg, of an adult.

HORIZON.—Shara Murun, Upper Eocene, Mongolia.

LOCALITY.—Ula Usu, Inner Mongolia (field No. 224).

DIAGNOSIS.— $I_3^3$ ,  $C_1^1$ ,  $P_3^3$ ,  $M_3^3$ ; teeth generally suggestive of *A. intermedius*: canines not hypertrophied; stub of root of  $dP^1$ , right, still present; internal cingula complete on  $P_2^{2-4}$  and  $M_2^{2-3}$ , but interrupted by the transverse crests on  $M^1$ ; transversely elongated hypostyles on  $P_2^{2-3}$ , parallel to, but distinct from, the immediately adjoining posterior cingulum, forming distinct crests, nearly or quite continuous, basally, with the protoloph; traces of cement on upper molar ectoloph; external and internal cingula unusually prominent (for members of the Amynodontidae) on all lower cheek teeth;  $P_2$  reduced in size;  $P_3$ -4 molariform, not greatly reduced in size; lower molars rectangular and not excessively elongated;  $M_2$  not appreciably longer than  $M_3$ ; large preorbital fossa; long alisphenoid canal; prominent paroccipital process; vertebral formula: 7 cervical, 17 thoracic, 4 lumbar, 5 sacral and pseudosacral, and 22 (+ 1?) caudal vertebrae; size order of *Melamynodon planifrons*, but proportions in general, and ratios of limb segments, in particular, as in *Amynodon intermedius*; radius not much compressed, anteroposteriorly; digit V of manus fully functional; metacarpals and metatarsals not shortened; distal phalanges nubbins, not indicating well-shaped hooves; deep pit on dorsal surface of femur just proximal to patellar groove, presumably for origin of a large m. suberureus; tuber calcis not flattened, dorso-ventrally.

This specimen has been mentioned briefly, without name or de-

<sup>1</sup> Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 132.

<sup>2</sup> The manuscript of this article had been completed at the time of Professor Osborn's death, November 6, 1935, and it is submitted to the editor without change except in the captions to the figures. The detailed description, comparative studies and measurements were prepared by Dr. Horace Elmer Wood, 2d, and checked and approved by Professor Osborn.—Walter Graeger.



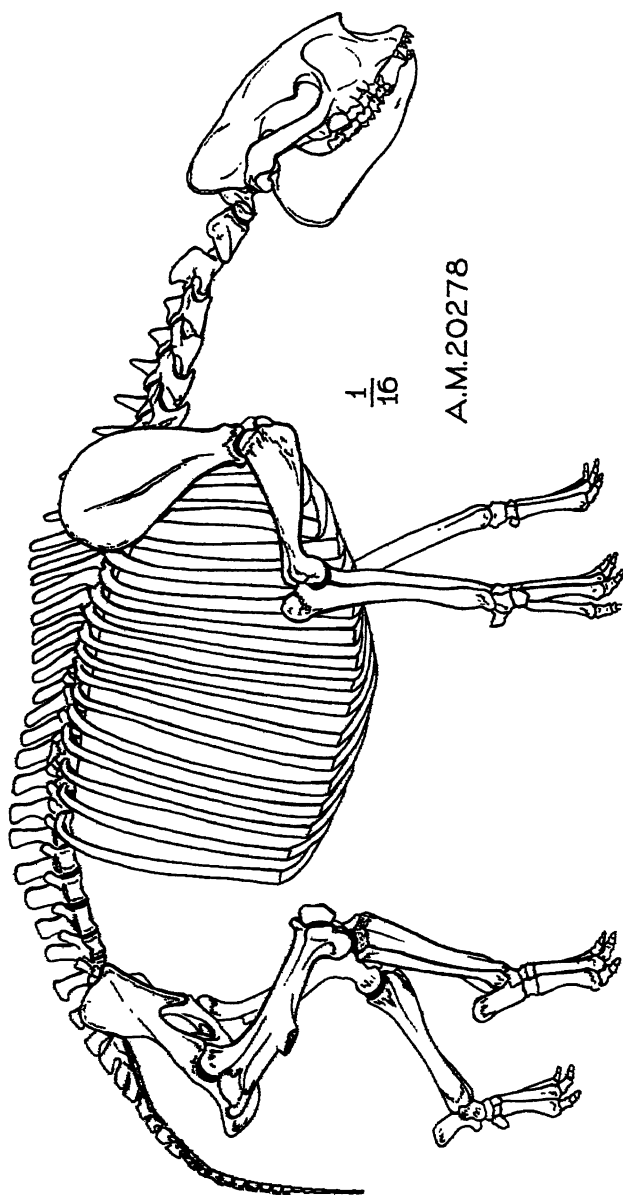


Fig. 1. *Amynodon mongoliensis*, new species. Amer. Mus. No. 20278, Type. Outline of skeleton traced from a photograph of the mounted specimen. One-sixteenth natural size.



Fig. 2. Skeleton of *Amynodon mongoliensis* lying in the matrix. Shara Murun beds, Ula Usu, Inner Mongolia, September, 1923. Collectors are Olsen, Johnson, and Kan ("Buckshot"). The skull, the muzzle of which was exposed when found, has been removed.

scription, by Berkey and Morris.<sup>1</sup> It is very doubtful whether it is the form indicated by Zdansky<sup>2</sup> as "*Amynodon?* sp.," and it obviously has no close relation to the relatively tiny *Amynodon sinensis* Zdansky.

	<i>Amynodon</i> <i>mongo-</i> <i>liensis</i> new species, type, A. M. 20278 mm.	<i>Amynodon</i> <i>inter-</i> <i>medius</i> Osborn, type upper dentition, P. U. 10309	<i>Amynodon</i> <i>inter-</i> <i>medius</i> referred lower dentition, A. M. 1963	<i>Amynodon</i> <i>sinensis</i> Zdansky, type upper, and referred lower dentition <sup>3</sup>
Right premaxillary to condyle.....	549.5			
Nasal to occiput.....	495 ±			
Width across zygomata (reduced by crushing).....	225 +			
Lacrymal duct to premaxillary.....	242			
Lacrymal duct to occipital condyle....	340.5			
Length of right ramus of mandible....	450			
Height of coronoid (average of both sides).....	245.5			
Length of P <sup>2</sup> -M <sup>3</sup> (average of both sides)	198.3	187.0		
Length of P <sup>2</sup> -4 (average of both sides)..	70.3	62.2		
Length of M <sup>1</sup> -3 (average of both sides)..	127.3	125.6		73.5
Length of P <sub>2</sub> -M <sub>2</sub> (average of both sides)	187.3	170.5		
Length of P <sup>2</sup> -4 (average of both sides)..	61.9		54.3	
Length of M <sup>1</sup> -3 (average of both sides)..	124.9		118.8	67
Length of M <sub>1</sub> (average of both sides)...	35.6		33.1	18.5
Length of M <sub>2</sub> (average of both sides)...	44.8		40.2	22.0
Length of M <sub>3</sub> (average of both sides)..	45.8		46.1	24.0
Height at withers.....	about 1400			
Length of trunk.....	about 1670			

Additional specimens which are presumably referable to this species are: A. M. No. 21601, the skull and lower jaws, with large parts of the skeleton doubtfully associated, of an old individual, with worn teeth, from the gray beds in the Shara Murun, collected in 1925, four miles north of Baron Sogin Lamasary; and the following individuals, all collected at Ula Usu, in the Shara Murun, in 1923:

<sup>1</sup> 'Geology of Mongolia,' Nat. Hist. Central Asia, II, p. 362.

<sup>2</sup> 'Die älteren Säugetiere Chinas nebst Stratigraphischen Bemerkungen.' Palaeont. Sinica, (C), VI, 2, pp. 42-50, Pls. II-III.

<sup>3</sup> Measurements from Zdansky.

A. M. No. 20279, left ramus of mandible with  $dP_{1-4}$ ;

A. M. No. 20282, left maxilla with  $dP_{1-4}$  and left ramus with a deciduous incisor and  $dP_{1-4}$ ;

A. M. No. 20283, both rami, with  $P_2-M_3$ , right, and  $M_{1-4}$ , left;

A. M. No. 20284, a face with  $dP_{2-4}$ , left, and  $dP_{2-4}$ , right.

The special resemblances of *A. mongoliensis* to *A. intermedius* should not be interpreted as due to direct migration by either species, but, rather, to parallel evolution in closely related lines.

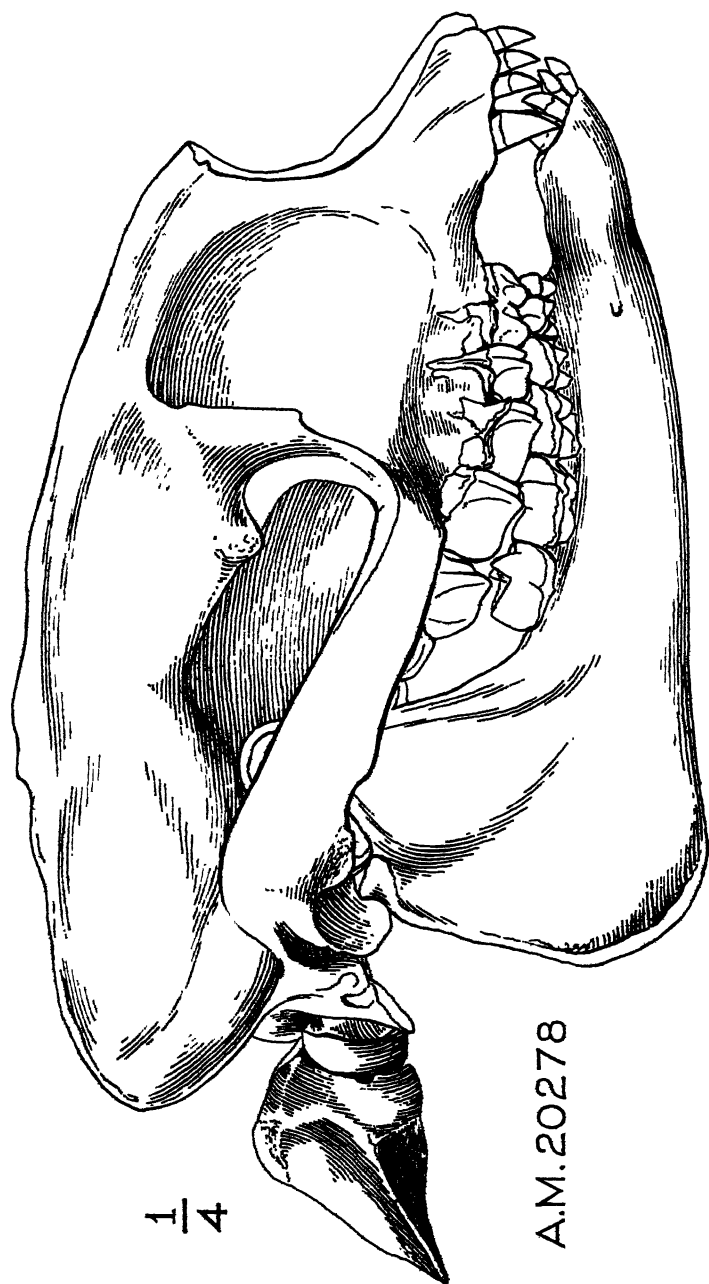


Fig. 3. *Amynodon mongoliensis*, Amer. Mus. No. 20278. Skull, mandible, and atlas vertebra. One-fourth natural size.

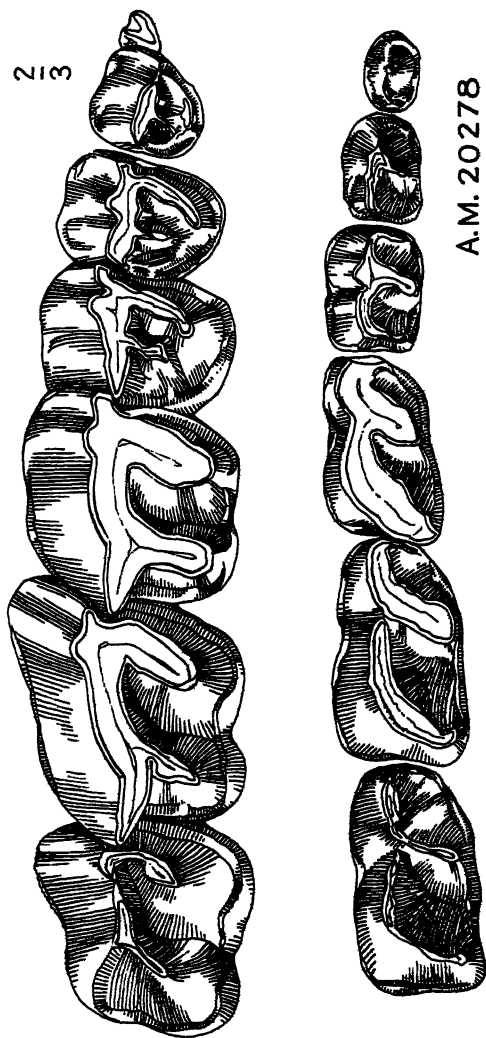


Fig. 4. *Amymodon mongoliensis*, Amer. Mus. No. 20278. Crown views of right upper and left lower cheek teeth. Two-thirds natural size.

$\frac{1}{2}$   
A.M.  
20278



Fig. 5. *Amynodon mongoliensis*, Amer. Mus. No. 20278. Front view of right manus. One-half natural size.

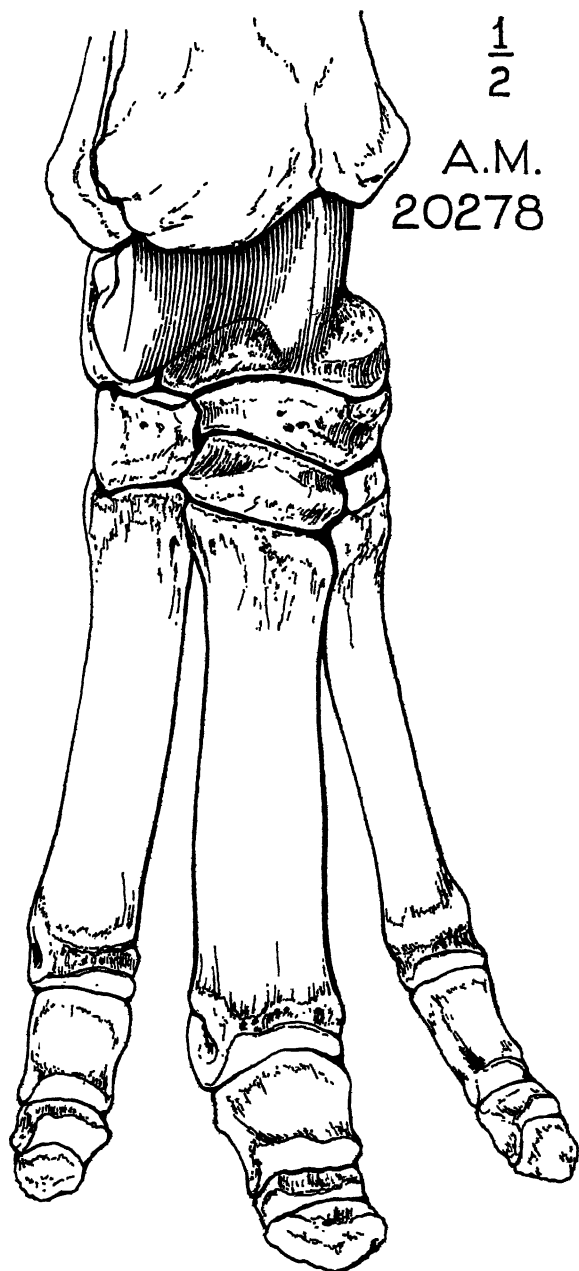


Fig. 6. *Amynodon mongoliensis*, Amer. Mus. No. 20278. Front view of right pes. One-half natural size.





# AMERICAN MUSEUM NOVITATES

Number 874

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

July 24, 1936

## PALAEOTRAGUS IN THE TUNG GUR FORMATION OF MONGOLIA<sup>1</sup>

BY EDWIN H. COLBERT

### INTRODUCTION

Among the fossils discovered by the Central Asiatic Expedition of 1930, of The American Museum of Natural History, are a fragmentary skull and several palates and mandibles that would seem to belong to a new species of *Palaeotragus*. All of these specimens came from the "Wolf Camp Quarry," about thirty-five miles southeast of Iren Dabasu on the Kalgan-Urga trail. They were found in the Tung Gur formation of Upper Miocene age.

The purpose of the present paper is to describe the above-mentioned fossils, to compare them with other giraffids and to point out the significance of their presence in the Tung Gur formation of Mongolia.

The author is indebted to Dr. Walter Granger, palaeontologist of the Central Asiatic Expeditions, for permission to study the material described in this paper. Mr. C. N. Astori prepared the illustrations.

### DESCRIPTION AND DISCUSSION

#### *Palaeotragus tungurensis*, new species

TYPE.—Amer. Mus. No. 26582, a partial skull with right  $P^1-M^2$ .

PARATYPES.—Amer. Mus. Nos. 26583, associated right and left mandibular rami with complete lower dentition; 26584, portion of maxilla with right  $P^1-M^2$ ; 26585, associated palate and left mandibular ramus with worn dentitions; 26586, palate with right and left  $P^1-M^2$  and associated left mandibular ramus with  $P_1-4$ ; 26587, portion of maxilla with left  $DM^{2-4}$ ,  $M^1-2$ ; 26588, portion of maxilla with left  $DM^{2-4}$ ,  $M^1$ , also right mandibular ramus with  $DM_{2-4}$ ,  $M_1$ ; 26589, right mandibular ramus with  $DM_{2-4}$ ,  $M_1$ ; 26590, right mandibular ramus with  $DM_{2-4}$ ,  $M_1$ ; 26591, right mandibular ramus with  $P_1-M_1$ ; 26592, left mandibular ramus with  $P_1-M_1$ ; 26593, left mandibular ramus with  $M_{1-2}$ .

HORIZON.—Tung Gur formation of Upper Miocene age.

LOCALITY.—All of the above listed specimens came from the "Wolf Camp Quarry," about five miles southwest of Gur Tung Khara Usu, Inner Mongolia.

DIAGNOSIS.—A large palaeotragine with a broad skull and a deep maxilla. Upper molars quadrate and hypsodont, with strong parastyle and mesostyle, and

<sup>1</sup> Publications of the Asiatic Expeditions of the American Museum of Natural History, Contribution No. 134.

with a strong ridge on the ectoloph of the paracone. Ectoloph of metacone concave and smooth. Internal crescents simple, with a slight projection on the posterior portion of the metaconule crescent. Median internal pillar either absent or but slightly developed.

Upper premolars robust and expanded laterally. External surface marked by a median vertical ridge and by very strong anterior and posterior folds, especially in  $P^{2-3}$ . A single internal crescent with an inner process projecting into the fossa.

Mandible long, with a convex lower border, but with a relatively short canine—premolar diastema. Incisors of medium size. Lower cheek teeth hypsodont. Ex-

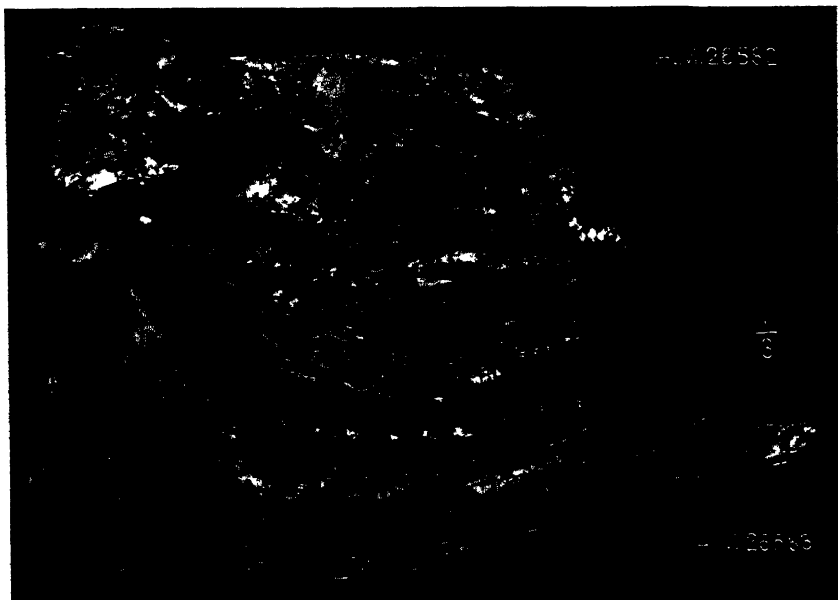


Fig. 1.—*Palaeotragus tungurensis*, new species. Type maxilla, Amer. Mus. No. 26582 and paratype mandible, Amer. Mus. No. 26583. Lateral views, right side. One-third natural size.

ternal crescents of lower molars rather flat, and no median pillar between protoconid and hypoconid. Lingual surfaces of metaconid and entoconid relatively flat. Meta-stylid weakly developed. Talonid of third molar relatively small.

Lower premolars relatively small. Third premolar lacking internal wall, so that its pattern is similar to the pattern of  $P_3$  in *Giraffokeryx*.

In all of the teeth the rugosity of the enamel is very fine.

#### DESCRIPTION OF THE UPPER AND LOWER DENTITIONS

The salient features of this new *Palaeotragus* are given in the above diagnosis. A full discussion will now be presented, comparisons will be

made between this Mongolian *Palaeotragus* and other Eurasiatic species, and at the same time other genera of Palaeotraginae will be considered for comparative purposes.

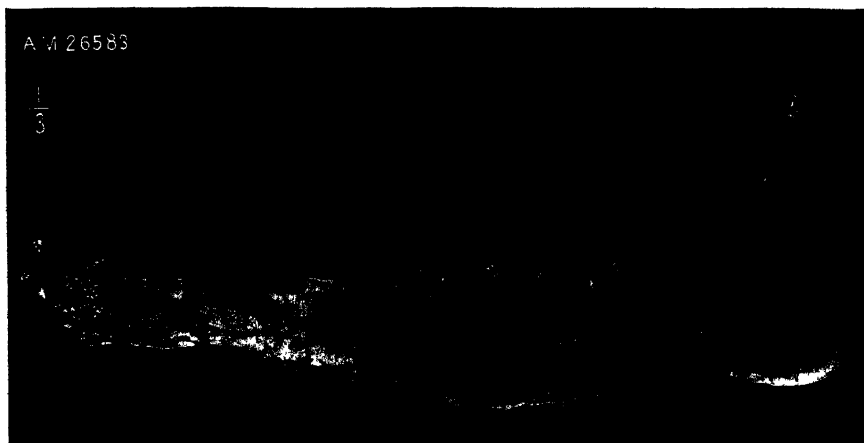


Fig. 2.—*Palaeotragus tungurensis*, new species. Paratype, Amer. Mus. No. 26583, left mandibular ramus. External lateral view. One-third natural size.

*Palaeotragus tungurensis* is a large species, closely comparable in size to *Palaeotragus coelophrys* (Rodler and Weithofer), described by Bohlin from the *Hipparion* beds of North China. The type skull (Amer. Mus. No. 26582, that of a hornless female) although rather incomplete, would indicate that this new species had relatively broad, flat frontals, in which respect it is again comparable to some of the North China forms. As in other palaeotragines, there is a large preorbital vacuity—a common ruminant character—and the maxilla is deep. Nothing else can be said about this skull, except that the optic foramen is visible, located within the vestibule leading to the common foramen lacerum anterius—foramen rotundum opening.

The upper cheek teeth are at once characterized by their hypsodonty and by the very fine rugosity of the enamel. Here again the species now under consideration is similar to the North China palaeotragines, es-

pecially to *Palaeotragus coelophrys*. The upper molars are similar to the corresponding teeth in other species of *Palaeotragus*; that is, the parastyle and mesostyle are very prominent, there is a strong vertical fold on the ectoloph of the paracone, but the same surface in the metacone is smooth and concave, while the protocone and metaconule are crescentic. These crescents are simple, except for the fact that there is a

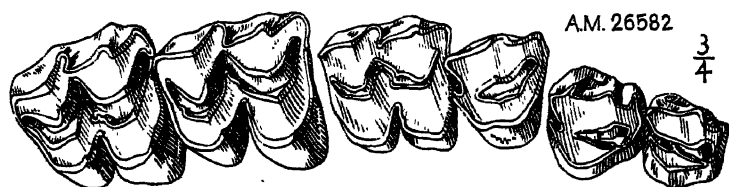


Fig. 3.—*Palaeotragus tungurensis*, new species. Type, Amer. Mus. No. 26582, right P<sup>2</sup>-M<sup>2</sup>. Crown view, three-fourths natural size.

very slight projection extending from the posterior wing of the metaconule crescent into the posterior fossette. Median internal pillars between the protocone and metaconule are either absent or, when present, very small. There are well-defined anterior cingula on the molars, and sometimes small internal cingula are present.

It is in the upper premolars that tangible differences between the upper cheek teeth of *Palaeotragus tungurensis* and other species are evident. Each upper premolar in the form under consideration consists of a single internal crescent, from the posterior portion of which a small projection extends into the fossette, and an ectoloph characterized by a strong median vertical ridge and extraordinarily well-developed anterior and posterior styles or folds. This last-mentioned character of the strong anterior and posterior folds would seem to be more or less definitive for *Palaeotragus tungurensis*. A considerable amount of variation is shown in these folds, in the several specimens at hand; consequently they shouldn't be given too much weight as specifically characteristic features. Nevertheless, these "premolar folds," if so they may be called, are developed to a degree in the new Mongolian species beyond that observed in most of the other species of the genus *Palaeotragus*.

In the type specimen the last upper premolar is similar to the cor-

responding tooth in other species of *Palaeotragus*, but in the second and third premolars the posterior styles are folded around so that they reach forward to the median vertical ridge of the ectoloph. The anterior styles of these two teeth are very strong. In one of the paratypes (Amer. Mus. No. 26584) there is a rather well-developed posterior fold on the

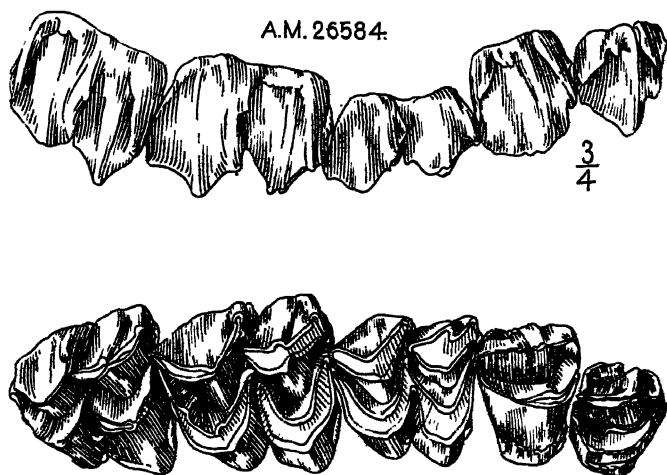


Fig. 4.—*Palaeotragus tungurensis*, new species. Paratype, Amer. Mus. No. 26584, right P<sup>3</sup>–M<sup>3</sup>. External lateral view above, crown view below. Three-fourths natural size.

last upper premolar, while in this same specimen and in another one (Amer. Mus. No. 26586) the anterior and posterior folds of the anterior premolars are unusually well developed. The character of these folded styles may be seen by examining the illustration (Fig. 4) of Amer. Mus. No. 26584. Bohlin has figured an upper second premolar of *Palaeotragus quadricornis* in which the anterior and posterior external styles are folded somewhat as in the teeth of the Mongolian species.

The paratype mandible (Amer. Mus. No. 26583) is an almost complete specimen. It is characterized by the relative shortness of its canine-premolar diastema, which is shorter than the combined length of the lower cheek teeth. In *Palaeotragus microdon*, as figured by Bohlin, the diastema is considerably longer than the lower cheek teeth. In *Sa-*

*mootherium* the canine-premolar diastema is about equal in length to the length of the lower cheek teeth, while in *Okapia* the diastema is somewhat longer than the length of the cheek teeth. Thus it would seem that *Palaeotragus tungurensis* has a primitively short canine-premolar diastema, and moreover it would seem that the diastema in the Mongolian species is relatively shorter than in any other species of *Palaeotragus* or than in any other genus of the Palaeotraginae. Of course it might be argued that the diastema in *Palaeotragus tungurensis* has been secondarily shortened, but this seems very unlikely in view of the comparatively early geologic age (that is, early in the phylogenetic history of the Giraffidae) of the Mongolian species.

The mandibular condyle is perhaps slightly less elevated above the alveolar border than is the case in *Palaeotragus microdon* or *Samotherium* or *Okapia*. In this respect it is likely that *Palaeotragus tungurensis* is more closely comparable to *Giraffokeryx* than to other members of the Palaeotraginae. The differences are, however, slight.

The coronoid notch in this new Mongolian species is rather broad and the coronoid process is slender. The mandibular condyle, transversely concave, is relatively narrow as might be expected in this early giraffid. The lower border of the mandible is curved, more so than in *Palaeotragus microdon* and *Giraffokeryx*, less so than in *Okapia*, and about the same as in *Samotherium*. The angle of the mandible is produced somewhat posteriorly.

The jaw now being discussed is characterized not only by the shortness of its diastema, as mentioned above, but also by the brevity of its symphysis. This feature, like the short diastema, would seem to be a primitive heritage character in the present species, and it is in distinct contrast to the elongated symphyses of the more advanced giraffids. Even *Palaeotragus microdon* would seem to have a longer symphysis than the Mongolian form.

The lower incisors are of medium size, being closely comparable not only in size but also by virtue of their elongate character to the *Palaeotragus* incisors from North China figured by Bohlin. These elongated incisors in *Palaeotragus tungurensis* again illustrate the retention of a primitive character, for in the more advanced giraffids the incisors become enlarged and spatulate as in *Giraffa*, or they are reduced in size as in *Okapia*. Unfortunately there is no canine preserved in *Palaeotragus tungurensis*.

As in the case of the upper teeth, the lower cheek teeth are very hypsodont, with finely rugose enamel. The lower molars are relatively narrow

in comparison to their length, a character that may be explained by the rather flat outer crescents, the protoconid and hypoconid. The metaconid and entoconid are oblique to the median axis of the tooth, and their internal surfaces are flattened. The metastylid is weakly developed and there is no external pillar between the protoconid and hypoconid. The hypoconulid of the third molar is relatively small, so that in the worn tooth it forms a single oval pillar rather than a U-shaped loop.

The lower premolars are proportionately small, that is, their combined length is less than the length of the first two molars. The second lower premolar consists of a simple outer wall with two posterior and one

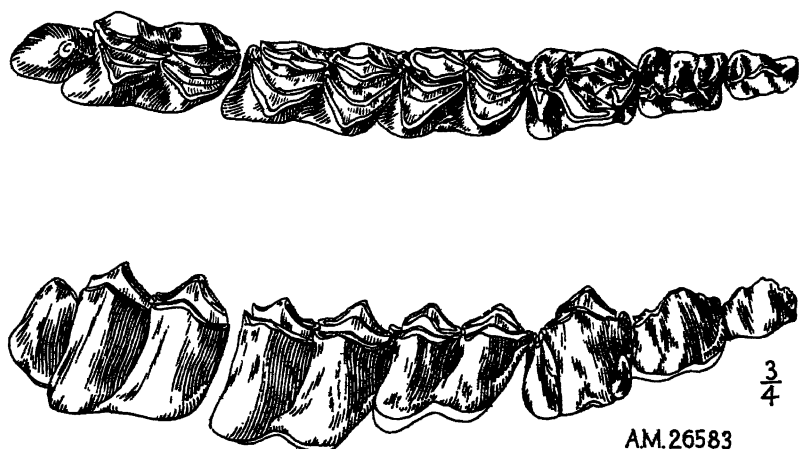


Fig. 5.—*Palaeotragus tungurensis*, new species. Paratype, Amer. Mus. No. 26583, right  $P_2$ – $M_1$ . Crown view above, external lateral view below. Three-fourths natural size.

median pillar or ridge projecting inwardly. The third premolar is an elaboration of this same plan; in it there are two anterior, one median and two posterior pillars that project in from the outer wall. This tooth in *Palaeotragus tungurensis* is like the corresponding tooth in *Giraffokeryx* and in *Achtiaria expectans* (= *Palaeotragus expectans*), described by Borissiak, rather than like the third premolars in other species of *Palaeotragus*. In the North China *Palaeotragus*, for instance, the third lower premolar is a replica of the fourth lower premolar, because it consists of an outer anterior crescent and an opposite inner oblique wall, followed by an outer posterior half crescent and another opposite inner oblique wall. We might think of the posterior two premolars in the North China *Palaeotragus* as progressing toward



molarization (in fact the anterior moieties of each of these teeth are molariform) while the corresponding teeth in *Palaeotragus tungurensis* are still in a more primitive stage of development, and might be considered as retaining a "cervid" pattern.

The last lower premolar of *Palaeotragus tungurensis* is a very difficult tooth to describe. In some ways it is more or less like the typical *Palaeotragus* fourth premolar, in others it shows certain characters that are exemplified in the last premolar of *Cervus*. To put it briefly, there is an anterior outer crescent, interrupted in its front portion by a deep sulcus. Internal to this there is an antero-posterior (not oblique) wall. Posteriorly there is an internal oblique wall that is in line with the posterior wing of the antero-external crescent, and external to this there is a sort of transverse pillar.

The accompanying diagram (Fig. 7) demonstrates in a much more lucid way than words can tell the premolar patterns in *Palaeotragus tungurensis* and in other members of the Palaeotraginae.

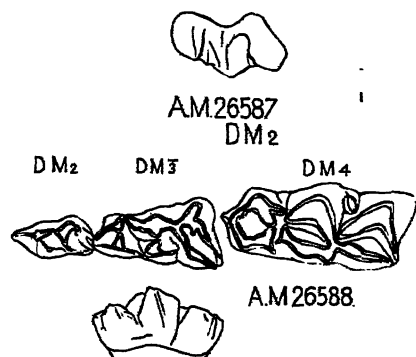


Fig. 6.—*Palaeotragus tungurensis*, new species. Above: paratype, Amer. Mus. No. 26587, left  $DM^2$ , external lateral view. Below: paratype, Amer. Mus. No. 26588, right  $DM^2-4$ , crown views, and internal lateral view of  $DM^3$ . All natural size.

The milk dentition of *Palaeotragus tungurensis* may be studied in some of the paratype specimens. The upper and lower deciduous cheek teeth will now be described in detail.

The second upper deciduous molar is essentially a replica of the second permanent premolar, except that it is much narrower in proportion to its length. Bohlin has demonstrated that in the fossil Palaeotraginae there is a constant, well-developed postero-external cingulum on  $DM^2$  (or, as it is often written,  $DP^2$ ), a character that is also found in the Giraffinae, while in *Okapia* and in the Sivatheriinae this cingulum is absent. The cingulum is large and prominent in the  $DM^2$  of *Palaeotragus tungurensis*, being comparable in its development to the corresponding

cingulum in the North China *Palaeotragus*. The third upper deciduous molar is molariform in its posterior part, that is it has a strong meso-style, a slight vertical expansion on the ectoloph and an internal crescent, while in its anterior portion the ectoloph is strongly expanded anteriorly and medially, and there is an inner wall that, when worn, joins the posterior internal crescent. The fourth upper deciduous molar is quite similar to the first upper permanent molar, so it need not be described here.

The second and third inferior deciduous molars are essentially replicas of the second and third permanent premolars, except that they are somewhat narrower in proportion to their length than are the permanent teeth. In  $DM_3$  the internal pillars or projections terminate in internal walls, thus closing the lingual side of the tooth. The fourth lower milk molar, as in other artiodactyls, consists of three pairs of molariform cusps, in this case, of course, in the form of inner walls and outer crescents. There is a well-developed external pillar between the two posterior crescents.

Measurements of the various specimens of *Palaeotragus tungurensis* are given in the accompanying table.

#### VARIATIONS IN *Palaeotragus tungurensis*

The specimens representative of *Palaeotragus tungurensis* show a certain amount of individual variation, not only as regards their comparative sizes, but also in the development of tooth structures. As to size, there would seem to be a variation of about twenty per cent in linear dimensions in this species. Thus in the upper molars, there is a range of variation (or dispersion) between the highest and lowest values for the combined length of these teeth of twenty two per cent, using the mean combined length as a basis of one hundred per cent. Similarly, in the lower molars the range of variation is twenty per cent, and in the lower milk molars the variation amounts to eighteen per cent. Of course these values might be changed somewhat if there were more specimens in the series.

The variable characters in the species under discussion are all of a minor importance. They may be briefly discussed here. As was shown in a preceding paragraph, the external cingula of the upper premolars may vary considerably in their development. An internal median pillar may be either present in the third upper molar, as in No. 26584, or absent as in most of the other specimens. This would seem to be the

Measurements of *Palaeotragus tungurensis*

## PALATE AND UPPER TEETH

PERMANENT DENTITION A. M. 26582, A. M. 26584 A. M. 26585 A. M. 26586  
type

Height of skull above M<sup>3</sup> 110 mm.

Width of palate, M<sup>1</sup>

68 mm.

P <sup>2</sup>	length	17			19 mm.
	width	17			18.5
P <sup>3</sup>	length	19	17 mm.	16	18
	width	18	19	17	21
	height		17		
P <sup>4</sup>	length	19	19	16	19
	width	21	24	19	24
	height		21		
M <sup>1</sup>	length	23	27	20	24
	width	23	26	23	28
M <sup>2</sup>	length	28	31	26	29
	width	29	29	25	29
	height		26		
M <sup>3</sup>	length	27	29	23	
	width	28	28	24	
	height		25		
P <sup>2-4</sup>	length	56			57
M <sup>1-3</sup>	length	77	81	65	

## DECIDUOUS DENTITION

A. M. 26587

A. M. 26588

DM <sup>2</sup>	length	16 mm.	18 mm.
	width	13	13
	height		14*
DM <sup>3</sup>	length	21	
	width	18.5	
DM <sup>4</sup>	length	21	22
	width	21	20
	height		15*
M <sup>1</sup>	length	27.5	24
	width	25	22
	height		19.5
DM <sup>2-4</sup>	length	58	

\* Restored Height.

## MANDIBLE AND LOWER TEETH

PERMANENT DENTITION	A. M. 26583	A. M. 26585	A. M. 26586	A. M. 26591	A. M. 26592	A. M. 26593
Length of mandible, condyle-symphysis	357 mm.					
C-P <sub>2</sub> diastema	106					
Depth of ramus, M <sub>3</sub>	40	48 mm.		51 mm.	59 mm.	54 mm.
I <sub>2</sub> width	10					
height	17					
I <sub>3</sub> width	8.5					
height	17					
P <sub>2</sub> length	13		14 mm.		12	
width	8.5		8.5			
P <sub>3</sub> length	18	15	16		15	
width	12.5	11	11.5			
P <sub>4</sub> length	19	18	20		22	
width	15	13			19	
height	20					
M <sub>1</sub> length	25	18		24	23	
width	16			19	20	
M <sub>2</sub> length	27	24		25	29	25
width	18	16		20	23	19
M <sub>3</sub> length	37	31		39	40	37
width	17	15		21	21	17
height	23					
P <sub>2-4</sub> length	49		51		50	
M <sub>1-3</sub> length	90	73		90	91	
DECIDUOUS DENTITION	A. M. 26588		A. M. 26589		A. M. 26590	
Depth of ramus, DM <sub>4</sub>			35 mm.		27.5 mm.	
DM <sub>2</sub> length	10 mm.		14.5		12.5	
width	6		6.5		5.5	
height			8		7	
DM <sub>3</sub> length	17		18		15	
width	9.5		10.5		8.5	
height					9*	
DM <sub>4</sub> length	24		30		24	
width	12		15		12	
height			14*		13*	
M <sub>1</sub> length	25		28		23	
width	15		16		15	
height	21		21			
DM <sub>2-4</sub> length	51		62		52	

\* Restored Height.

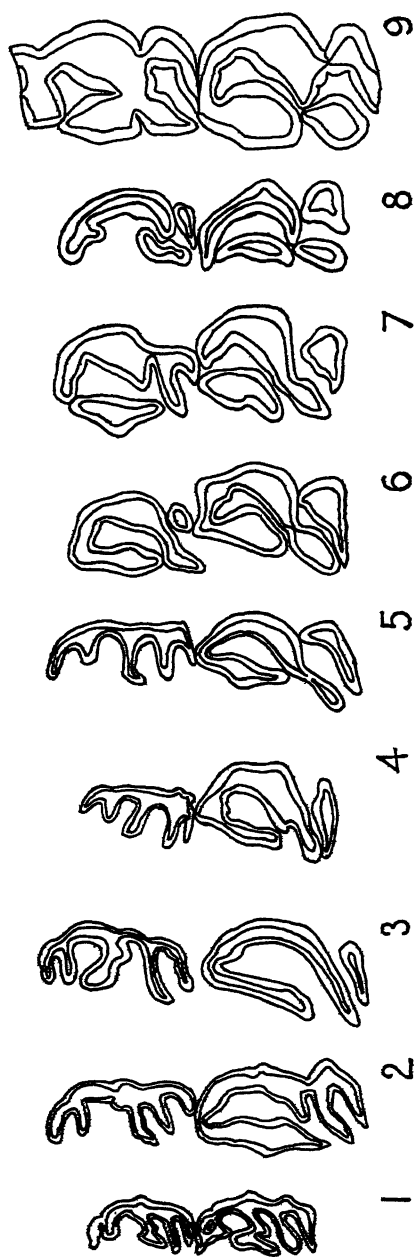


Fig. 7.—Enamel patterns of right  $P_{3-4}$  in various giraffids and in a cervid.

1. *Cervus unicolor*. 2. *Giraffokeryx punjabiensis*. 3. *Palaeotragus expectans*. 4. *Palaeotragus tungurensis* (A. M. 26583). 5. *Palaeotragus quadricornis*. 6. *Palaeotragus microdon*. 7. *Palaeotragus coelophrys*. 8. *Okeapia johnstoni*. 9. *Giraffa camelopardalis*.

3. Adapted from Borissiak, 1914. 5, 6, 7. Adapted from Bohlin, 1927. All natural size.

only upper molar in which there is a median pillar, when one is present. Likewise, there may or may not be a small internal cingulum in this tooth. In the lower molars there may or may not be external pillars; they are well developed in No. 26585. There would seem to be a certain amount of variation in the heaviness or robustness of the mandibular ramus. In No. 26583 it is rather thin and slender, while in No. 26592 it is very heavy. As to the milk dentition, the external cingulum of the second upper milk molar, cited by Bohlin as being particularly characteristic of the Palaeotraginae, may show considerable size variation, while in the fourth lower milk molar the external pillars may be either large or small.

#### COMPARISONS WITH OTHER MEMBERS OF THE PALAEOTRAGINAE

*Palaeotragus tungurensis* has already been compared in detail with other palaeotragines, in the preceding pages of this paper. It may be useful, however, to recapitulate the various points whereby this giraffid either resembles or differs from other genera and species of the Palaeotraginae.

As to size, this is a comparatively large form, being closely comparable in this respect to *Palaeotragus coelophrys* from North China. The Mongolian species resembles the North China species in certain other characters also, particularly by reason of the hypsodont cheek teeth with finely rugose enamel, and by the rather long lower incisors. There are unusually strong external folds in the upper premolars, especially  $P^2$  and  $P^3$ , of *Palaeotragus tungurensis*, whereby this species would seem to resemble *Palaeotragus quadricornis* more than any other species of the genus. An external cingulum is well developed on the second upper deciduous molar, as in other genera of the Palaeotraginae. (*Okapia*, placed by many authors in this subfamily, lacks the fold.) The enamel patterns of the lower premolars in *Palaeotragus tungurensis* are similar to the patterns in *Giraffokeryx* and in *Palaeotragus expectans* as regards  $P_3$ , rather than to those of other species of *Palaeotragus*. Another character that is quite distinctive of *Palaeotragus tungurensis* is the short diastema of the mandible; it is relatively shorter than in the North China *Palaeotragus* or than in *Okapia*, and it may be compared with the rather short diastema of *Samotherium*. In both *Palaeotragus tungurensis* and *Samotherium* the canine-premolar diastema is shorter than the combined premolar-molar length, while in other palaeotragines it is longer than the premolar-molar length. Another point that might

be mentioned as characteristic of *Palaeotragus tungurensis* is the relatively small lower premolars.

## CONCLUSIONS

### AFFINITIES OF *Palaeotragus tungurensis*

It would seem as if the new species described in this paper is perhaps more closely related to the several species of *Palaeotragus* from North China, and in certain respects to *Palaeotragus expectans* from Sebastopol, than to any other forms. Common characters between the Mongolian and China species are to be found in the large size, the hypsodont cheek teeth with finely rugose enamel, the strong folds in the upper premolars and the rather long lower incisors. In the pattern of the lower premolars and the short mandibular diastema we may see in *Palaeotragus tungurensis* primitive characters that cause it to resemble on the one hand *Giraffokeryx* and *Palaeotragus expectans*, and on the other *Samotherium*.

Should the Mongolian form be referred to another genus of the *Palaeotraginae*, or should a new genus be created for it? The answer to this question is, that in the preponderance of its characters it resembles not only the generic type, *Palaeotragus rouenii*, but also (and more particularly) the North China species; so there seems to be no need for considering it as belonging to any genus other than *Palaeotragus*.

When the material described above as *Palaeotragus tungurensis* was first examined, there arose the question as to whether it might be representative of a large cervid rather than of a giraffid. The pattern of the lower premolars, the short diastema and the long lower incisors are all characters that would indicate a possible cervid relationship. There are, however, many true giraffid characters in these specimens, characters that indicate a real relationship with *Palaeotragus*. These are the lack of a vertical fold on the ectoloph of the metacone, the structure of the upper premolars, the flattened lingual surfaces of the lower molars and the large size. This last character is of real significance, because in Upper Miocene or Lower Pliocene times the cervids had not yet attained the large size characteristic of some of the Pleistocene and recent forms. The cervid-like characters of *Palaeotragus tungurensis*, likewise are true giraffid characters, to be found in other types of *Palaeotraginae*. As has been shown in some preceding paragraphs, the finely rugose enamel and the long lower incisors are to be seen in the North China *Palaeotragus*, the premolar pattern is found in *Giraffokeryx* and in *Palaeotragus expectans*, while the short diastema occurs in *Samotherium*.

THE BEARING OF *Palaeotragus tungurensis* ON THE CORRELATION OF THE TUNG GUR FORMATION

The presence of *Palaeotragus* in the Tung Gur formation of Mongolia doesn't offer any additional conclusive evidence for placing these beds either in the Miocene or in the Pliocene periods. The Tung Gur formation was tentatively regarded as of Pliocene age by Spock (1929, 1930) on the basis of its stratigraphic relationships. Osborn, in 1929 and 1932 placed the Tung Gur in the Pliocene because of the proboscideans, *Platybelodon* and *Serridentinus*, that were found in these beds. Subsequently it was regarded as of Upper Miocene age because it contains a *Listriodon* comparable to *Listriodon splendens* (Colbert, 1934), because a beaver, *Amblycastor tungurensis*, similar to North American forms of Lower Snake Creek age occurs here (Stirton, 1934), and because *Anchitherium* is present but *Hipparion* is not, while the antelopes, *Oioceros grangeri* and *Oioceros noverca*, would seem to be more primitive than related Pontian forms (Pilgrim, 1934). None of the above associations offers really definite proof as to the age of the Tung Gur formation. *Platybelodon* might be either an Upper Miocene or a Lower Pliocene proboscidean. *Listriodon*, although a typical Middle and Upper Miocene suid, persists on into the Pliocene in India, and the same is true of *Anchitherium* in North China. *Oioceros* is a genus extending from the Miocene into the Pliocene. It is conceivable, too, that *Amblycastor*, although of Miocene affinities, might have persisted into the Pliocene in Asia. Perhaps the fact that *Hipparion* is absent from the Tung Gur formation is the strongest argument against placing these beds in the Pliocene.

*Palaeotragus tungurensis* might be considered either as of Miocene or as of Pliocene age, or to be more specific, it may be either of Sarmatian (or Tortonian) or of Pontian affinities. It closely resembles the North China *Palaeotragus*, which is found in the *Hipparion* beds, and then again it has many affinities (especially in the primitive lower premolars) with *Palaeotragus expectans*, described by Borissiak from the Sarmatian of Sebastopol.

Thus the age of the Tung Gur formation is still left as a somewhat debatable question. Since *Hipparion* is not present in this formation (its absence would seem to be real and not due to the vagaries of collecting), since the antelopes are more primitive than their Pontian relatives, since the rodents (including those recently described by A. E. Wood) are of Miocene affinities, since a rhinoceros (now being studied) is also



of Miocene affinities and since some undescribed carnivores would seem to be more primitive than the Pontian forms, there are strong logical justifications for regarding the Tung Gur formation as of Upper Miocene age.

A list of the Tung Gur fauna, as known from *described* forms is presented below.

PISCES

*Rhineastes grangeri* Hussakof

REPTILIA

*Testudo* cf. *shensiensis* Wiman

*Ocadia*(?) *perplexa* Gilmore

*Trionyx sculptus* Gilmore

AVES

*Eogrus* sp. Wetmore

MAMMALIA

*Amblycastor tungurensis* Stirton

*Protalactaga tunggurensis* Wood

*Prosiphneus lupinus* Wood

*Platybelodon grangeri* Osborn

*Serridentinus gobiensis* Osborn

*Macrotherium brevirostris* Colbert

*Macrotherium* sp. Colbert

*Listriodon mongoliensis* Colbert

*Stephanocemas thomsoni* Colbert

*Stephanocemas triacuminatus* Colbert

*Dicrocerus grangeri* Colbert

*Dicrocerus* sp. Colbert

*Palaeotragus tungurensis* Colbert

*Oioceras* (?) *grangeri* Pilgrim

*Oioceras* (?) *noverca* Pilgrim

SUPPLEMENTARY NOTE

Some isolated foot bones, particularly a calcaneum, an astragalus, a cuboid-navicular and the distal portion of a metatarsal, discovered in the Tung Gur formation at a locality about ten miles west of Gur Tung Khara Usu, may be referable to *Palaeotragus*. Since they were not associated with the dentitions described in the foregoing pages of this paper, and since their assignment to the genus *Palaeotragus* is at best very doubtful, it would seem advisable not to include them in this description.

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# AMERICAN MUSEUM NOVITATES

Number 875

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

July 31, 1936

## SOME NORTH AMERICAN OSMIINAE (HYMENOPTERA, APOIDEA)

By CHARLES D. MICHENER

The following paper is based on specimens obtained very largely in California and in Colorado, although other western states—such as Idaho, Arizona, New Mexico, Wyoming, Washington, Texas—as well as North Carolina and Mexico are also represented in the records. The author is indebted to a number of different collectors for material supplied. The names of these collectors are noted in connection with the species reported upon. Practically all the specimens are from the collections of The American Museum of Natural History, of Prof. T. D. A. Cockerell and of the author. I wish to express my special gratitude to Prof. Cockerell for the opportunity of examining his collection, and for many kindnesses extended to me. The holotypes of the new species herein described have been placed in The American Museum of Natural History. Descriptions of certain species mentioned in the keys of this paper have been sent elsewhere for publication.

### ASHMEADIELLA

The bees of the genus *Ashmeadiella* are confined to North America, having been reported from British Columbia on the north to Yucatan on the south. They are most abundant and diversified in the dry regions of our southwestern states, where a large proportion of the species are found. About seventeen species have been recorded from California.

Existing descriptions of species of this genus are very poor, too much emphasis having been placed on such characters as the color of the tegulae, and too little on structure and punctuation. For this reason many of the species can not be definitely identified from the descriptions. In order to rectify this condition as much as possible, notes are here given on many of the previously described species. With the original descriptions, supplemented by these notes and the keys, it is hoped that the species may be correctly determined.

I have included *Titusella* in the keys, as it is very close to *Ashmeadiella*, the chief characters for its separation being the broad mandibles of *Titusella* and the form of the clypeus, which is variable within *Ashmeadiella*. The lengths of the joints of the labial palpi are hardly

of value in separating these two genera, *Titusella* merely presenting one extreme, as will be seen by the following tabulation:

First joint of labial palpi one and one-half times as long as second.

*A. maxima* Michener.

First joint of labial palpi but little longer than second.

*A. denticulata* (Cresson), *A. bigeloviae* (Cockerell), *A. cactorum cactorum* (Cockerell), *A. c. aridula* (Cockerell), *A. timberlakei* Michener.

First joint of labial palpi about equal to second.

*A. coloradensis* Cockerell, *A. basalis basalis* Michener, *A. californica californica* (Ashmead).

First joint of labial palpi a little shorter than second.

*T. cubiceps* (Cresson), *T. clypeata* Michener.

Unfortunately, male *Titusella* is unknown.

### Ashmeadiella coloradensis Cockerell

This species varies from the brightly colored form described by Cockerell to the entirely black form. A cotype has the red confined to the first two tergites, the legs being entirely black.

FEMALE.—Length 5 to 6½ mm. Facial line a little longer than transfacial; vertex and scutum shiny with moderate-sized, dense punctures<sup>1</sup>; punctures of clypeus, which has a slightly concave truncation at the apex, a very little coarser than those of vertex; abdomen not as closely punctate as in the male, distinctly more finely punctate than the vertex. Pubescence much as in the male but not covering clypeus; the pair of hair tufts on anterior margin of scutum inconspicuous. Legs black, or hind femora and sometimes area on inner sides of hind tibiae red; abdomen black, or first tergite red, the second and third red except in the middle (less red on third than on second).

Boulder, and White Rocks near Boulder, Colorado, July 8, 1935, on *Petalostemon* and *Psoralea tenuiflora* (Cockerell and Michener, collectors); one female, with red, from Aliso Canyon, Los Angeles County, California, May 3, 1931 (Michener). The latter record is very interesting, as Aliso Canyon is on the north side of the San Gabriel Mountains in desert country. The Californian specimen seems a little more finely punctate than Colorado specimens, and the discovery of Californian males may show that it is a distinct species.

The median apical teeth of the male abdomen are variable. They may be triangular as in the types or similar to those of *A. denticulata* (Cresson). The female is difficult to distinguish from *A. cactorum* (Cockerell) without specimens for comparison, but the male is easily separated by the short apical teeth of the abdomen. *A. coloradensis* is more finely punctate than *A. cactorum*, but the differences are difficult

<sup>1</sup> Vertex of male punctured as in the female, but scutum more sparsely punctate.

to indicate in a key, and *A. coloradensis* is unusually variable, so that some individuals show but little difference in punctuation from *cactorum*. Considering the variability of both sexes of *A. coloradensis*, I think it probable that there are two species. However, since the male genitalia are the same, I do not wish to separate a new form now.

#### *Ashmeadiella howardi* Cockerell

##### Figure 1

**FEMALE.**—Apex of clypeus broadly rounded, minutely crenulate, the margin "very broadly somewhat shining." "Vertex more densely punctured than mesothorax or scutellum, but not more coarsely." (Cockerell, in litt., 1935, notes from type.)

**MALE.**—Tegulae vary from nearly black to reddish; red of abdomen sometimes extending back at extreme sides to fifth segment. Median teeth at apex of abdomen rather slender, not much widened at bases, somewhat parallel-sided, sometimes black; lateral teeth at apex of abdomen broad, making the lateral margins to sixth tergite convex, after the manner of *A. timberlakei* Michener.

Two males which agree with Cockerell's original male are from Eagle Rock Hills, Los Angeles County, California, April 14, 1932, on *Rhamnus crocea* (Michener, coll.). The female is distinguished from all other species by the form of the clypeus.

#### *Ashmeadiella submaxima*, new species

**MALE.**—Length nearly 8 to 9 mm. Similar in general appearance and in structure to *A. maxima* Michener, differing as follows: head not quite so wide; punctures of vertex a very little coarser, but scutum rather dull, its punctures considerably finer; punctures of abdomen sparser, those of middle of second tergite separated by more than their diameters; median teeth at apex of abdomen very slightly longer; anterior margin of scutum without a pair of hair spots; claw joints of tarsi ferruginous.

Two from Walsenburg, Colorado, June 14, 1919, about 37° 37' N., 104° 47' W., and about 6200 feet altitude (F. E. Lutz).

The apex of abdomen is almost exactly like that of *A. californica* (Ashmead).

#### *Ashmeadiella arizonensis*, new species

**MALE.**—Length nearly 7 mm.; black; flagellum brown beneath; mandibles with a bright red transverse band; legs very dark brown, the apical joints of tarsi reddish; tegulae with a brown spot; extreme sides of tergites and posterior margins of first few tergites dark brown. Inner orbits hardly converging below, their lower ends slightly diverging; facial line a little shorter than transfacial; clypeus shining, rather coarsely but not densely punctured; rest of head and thorax densely punctured, the vertex shining with moderate-sized punctures, the scutum dullish with quite small punctures; pleura punctured more like the vertex; abdomen with moderate-sized punctures, larger than those of scutum, well separated on dorsum of first few tergites,

closer on posterior and lateral parts of abdomen; median teeth at apex of abdomen quite long, though not twice as long as basal width; lateral teeth shorter but fairly slender. Pubescence white, abundant on sides of face, around antennae, under apical margin of clypeus, on pleura (especially the edges), on scutellum, and on anterior edge and sides of scutum; first to fourth tergites with narrow hair bands, that of first tergite widened at sides; no pair of hair tufts at anterior edge of scutum. Wings clear.

Kits Peak, Rincon Baboquivari Mountains, Arizona, August 1-4, 1916 (one specimen).

Related to *A. submaxima* Michener, which has different coloration, more abundant pubescence, and slightly finer punctures on abdomen. *A. opuntiae* (Cockerell) is related, but has a longer head, has finer punctures on first two tergites, and is differently colored, having black legs. In general appearance, *A. arizonensis* is more slender than *A. maxima* Michener and *A. submaxima* Michener, but more robust than *A. opuntiae* (Cockerell), and smaller than any of these. *A. arizonensis* resembles *A. opuntiae* and differs from its other relatives by the coarsely punctured clypeus.

#### *Ashmeadiella opuntiae* (Cockerell)

A male from Palm Springs, California, March 24, 1935 (W. P. Cockerell) was determined by Timberlake as *opuntiae*.

MALE.—Length about 7 mm. Face nearly covered with white pubescence; pleura rather copiously hairy. Mandibles and antennae black. Vertex and scutum shining, with rather close punctures, those of vertex moderate-sized, those of scutum rather small; abdomen with rather fine, fairly close, punctures, those of first tergite larger than those of second; teeth at apex of abdomen black, the median ones long, parallel-sided, subtruncate at apex, somewhat widened at base, not quite twice as long as basal width. Wings very faintly grayish.

Probably most closely related to *A. arizonensis* Michener, which it resembles in the coarsely punctured clypeus.

#### *Ashmeadiella buconis* (Say)

A female from Fedor, Texas, and a male from Durant, Oklahoma, June 2, 1905, on *Verbesina helianthoides* (C. R. Jones, coll.) are referred to this species. They agree with Robertson's description. The female differs from *A. denticulata* (Cresson) by the coarser punctures throughout, especially on the cheeks, and by the darker scopa. In the male the differences of punctuation are evident, but not quite so conspicuous. The wings of *A. buconis* are darker than in *A. denticulata*. In this and the next species the vertex and cheeks are prolonged farther behind the eyes than in any other forms.

**Ashmeadiella denticulata** (Cresson)

## Figure 2

Specimens from California and Texas average somewhat smaller than those from New Mexico. Also, the heads of small specimens are somewhat less extended behind the eyes. However, it appears that there is but one species involved.

Mr. P. H. Timberlake has seen the type of *A. wislizeni* Cockerell and states that it is surely the same as *A. denticulata*. No doubt *A. rotundiceps* (Cresson) is the female of *A. denticulata*. *A. osmoides* (Cresson), originally described as a *Megachile*, is probably either *A. denticulata* or *A. buconis*. If it is found to be *denticulata*, this species will have to be called *A. osmoides*. It may be that *A. denticulata* should be considered a western subspecies of *A. buconis*.

California: Eagle Rock Hills and Altadena, both in Los Angeles County; San Jacinto; Corona; Murrieta; Rathbon Creek, San Bernardino Mountains; Oro Grande, Mojave Desert; dates from June 22 to September 14, on *Aster*, *Croton californicus*, *Senecio douglasii*, and *Isocoma veneta* var. (Michener, coll.). Riverside, dates from August 21 to September 28, on *Gutierrezia sarothrae* (Timberlake, coll.). Cajon Valley, July 2 (Cockerell).

Arizona: Oak Creek Canyon, elevation 6000 feet, August (F. H. Snow).

New Mexico: Las Vegas, August, on *Verbesina enceloides* and *Solidago canadensis* (W. Porter, coll.).

Colorado: Boulder, August (S. A. Rohwer), and July 8, 1935 (Michener); Livermore, August 17, 1903.

Texas: Devils River, May 6, 1907, on *Ratibida columnaris* and *Maribaundium origanifolium* (F. C. Bishopp, coll.).

**Ashmeadiella coquillettii** Titus

A female from Auburn, Placer County, California, July 8, 1929, collected from red cedar slabs (Calif. Dept. Agr. No. 29318) has been identified as this species by Sandhouse. Presumably it was compared with the type.

**FEMALE.**—Length  $6\frac{1}{2}$  mm. Similar to *A. californica* (Ashmead) but clypeus duller, with punctures only a little larger than those of vertex; punctures of scutum a little coarser than in *californica* and a little coarser and sparser than those of vertex; punctures of abdomen distinctly coarser and closer than in *californica*. Pubescence not as ochraceous as described by Titus. Mandibles with a reddish band close to apex; tegulae largely reddish. Wings faintly grayish.



*Ashmeadiella echinocerei* Cockerell

The following notes are on a specimen from Puerto Refugio, Gulf of California. I have not seen specimens from the type locality.

**FEMALE.**—Similar to *A. cactorum* (Cockerell) but smaller and less slender; punctation of vertex and scutum quite fine and very dense, these parts shining only slightly; punctures within ocellar triangle coarser than elsewhere on top of head; pleura more sparsely punctate than scutum; abdomen more finely punctate than in *A. cactorum*, its punctures hardly finer than those of scutum.

The name *A. echinocacti* Cockerell (Ann. Mag. Nat. Hist., 1931) is a slip for *echinocerei*.

*Ashmeadiella leucozona* Cockerell

I have examined a cotype of each sex.

**MALE.**—Vertex more finely and closely punctate than scutum, both shiny, especially the latter; abdomen with rather small, not very close, punctures, finer than those of vertex; lateral teeth at apex of abdomen pointed; median teeth about as broad as long (not twice as broad as long<sup>1</sup>).

**FEMALE.**—Clypeus truncate at apex, as usual in the genus; scutum and vertex contrasting as in the male; abdomen punctured as in the male.

*Ashmeadiella basalis basalis*, new subspecies.

**MALE** (type).—Length 5 to 5½ mm. Facial line longer than transfacial; eyes converging below except at extreme lower ends; mandibles and antennae black. tegulae testaceous; head slightly shining with rather small, rather dense punctures; Scutum with smaller, denser punctures; pleura with sparser punctures. Wings clear. Legs black, the basal third of hind femora red (hardly so in one specimen). Abdomen with rather small, not dense, punctures, finer in center of third tergite than in center of second; first tergite red except for a black area on dorsum; second tergite red at extreme sides (in one specimen there is also some brownish red at sides of some of the other tergites); apex of abdomen with the usual four teeth, the lateral ones red or black, acutely pointed, the median ones rather variable in shape, longer than basal width, in one specimen nearly twice as long as basal width. Pubescence not abundant, dull pale ochraceous on face, vertex, and dorsum of thorax, elsewhere nearly white; pubescence fairly abundant on face but not obscuring surface except laterally; front of scutum with two poorly defined hair spots; abdomen with narrow bands on first to fifth tergites.

**FEMALE.**—Length 5 to 6 mm. Facial line longer than transfacial; eyes converging below; mandibles and antennae black; clypeus truncated, the truncation a little concave; anterior third of clypeus very dull and finely punctate, without the usual narrow, more or less shining, margin; rest of face slightly shining, with moderate-sized close punctures; vertex more strongly shining, with larger, less close, punctures. Scutum dullish, with fine close punctures, strongly contrasting with the vertex; tegulae dark testaceous; pleura slightly more coarsely punctured than scutum. Legs black, the basal two-thirds or three-fourths of hind femora red. Abdomen black, the sides of first three tergites and sometimes entire first tergite red; dorsum of first

<sup>1</sup> Possibly this is the "variety a" but it is not so marked.

few tergites with punctures a little smaller and considerably sparser than those of scutum; posterior tergites and sides of anterior ones more coarsely and closely punctate. Pubescence white, slightly ochraceous on dorsum of head and thorax, a little less abundant than in the male.

California: Altadena (type locality), on dates from April 8 to August 2 (Michener); Florence Lake, Fresno County, July, 1932 (Michener); Mountain Home Creek, San Bernardino Mountains, elevation 5000 feet, August 15, 1934 (Timberlake). Flower records are *Lotus scoparius*, *Senecio douglasii*, and *Pentstemon ternatus*. I am indebted to Mr. Timberlake for the female of this species.

The dull and finely punctate anterior margin of the clypeus distinguishes the female from all other species. The male is rather easily recognized by the arrangement of red on the abdomen and hind legs. (See additional characteristics given in the key to the species.)

**Ashmeadiella basalis nigra**, new subspecies

MALE AND FEMALE.—Similar to typical *A. basalis*, but legs and abdomen without red; tegulae black or nearly so. The female is the type.

Boulder, Colorado (type locality), July, 1935 (Michener), May 26, 1908 (Rohwer); Las Vegas, New Mexico, August 4, on *Convolvulus arvensis* (W. Porter, coll.).

The male of this form has been considered the male of *A. prosopidis* (Cockerell), but I collected females at Boulder which show that it is not related to the true *A. prosopidis* from southern New Mexico. True *A. prosopidis* does not show a distinct difference between the punctation of the vertex and that of the scutum.

My Boulder specimens were collected around a pile of small dead logs and branches of trees, where they were probably nesting, and were called to my attention by Dr. C. H. Hicks.

**Ashmeadiella curriei** Titus

A male from Olympia, Washington, July 1, 1896 [previously recorded by Cockerell as *A. prosopidis* (Cockerell)] is, no doubt, the male of *curriei*.

Length about 5 mm. Facial line longer than transfacial; pubescence of face rather sparse for a male, not obscuring surface except on sides; mandibles and antennae black; vertex and scutum rather dull, with small close punctures, those of vertex a little coarser than those of front or scutum; tegulae black anteriorly, faintly reddish posteriorly. Wings slightly dusky. Abdomen finely and quite closely punctured; teeth at apex of abdomen short, the lateral ones broad and pointed, the median ones rounded, not as long as width at base; extreme sides of tergites brownish. Pubescence rather sparse, white, slightly ochraceous in most lights around antennae, on clypeus, and on scutellum.

*Ashmeadiella prosopidis* (Cockerell)

A female from Mesilla Park, New Mexico (Cockerell), is undoubtedly true *A. prosopidis*.

Facial line considerably longer than transfacial; apex of clypeus truncated as usual in the genus. Punctures of vertex and scutum moderately large, punctures of abdomen conspicuously finer than those of thorax, especially on dorsum of first three tergites.

Specimens recorded from Las Vegas, New Mexico, and Boulder, Colorado, are *A. basalis nigra* Michener, while the record for Olympia, Washington, refers to *A. curriei* Titus.

*Ashmeadiella schwarzi* Titus

The following notes are on a specimen from Guaymas, Mexico, previously recorded as *A. schwarzi*.

FEMALE.—Facial line about as long as transfacial; vertex and scutum shining, closely and rather finely punctured; abdomen punctured very similarly, a little more finely so on dorsum of first three tergites. Wings clear. Scopa grayish white; pleura margined with pale hairs; anterior margin of scutum with two confluent hair spots.

The punctuation of thorax dorsally is not more separate than elsewhere, and the clypeus is not densely covered with hair, as noted by Titus. Perhaps the Mexican specimens represent a species distinct from the Arizona *schwarzi*.

*Ashmeadiella cactorum cactorum* (Cockerell)

There are four specimens in the Cockerell collection, some of which have been recorded as the female of *A. meliloti* (Cockerell). I believe that the differences between *cactorum* and *meliloti* are sexual, the recorded female *meliloti* being *cactorum*. Note how close both sexes come in the keys to *A. cactorum aridula* (Cockerell).

FEMALE.—Length 6 to 7½ mm.; slender. Facial line a little longer than transfacial; clypeus truncate at apex, the truncation slightly concave; punctures of clypeus considerably larger than elsewhere; vertex, scutum, and pleura rather shining, with moderate-sized or rather large close punctures; punctures of abdomen moderate-sized, smaller than those of thorax, separated by less than their diameters even on dorsum of first three tergites. Tegulae black or piceous. Anterior margin of scutum with two conspicuous spots of hair; scutellum with copious pubescence.

New Mexico: La Cueva, Organ Mountains, September 8, on *Phacelia congesta* (Townsend, coll.); Mesilla, June 24 (Cockerell). Arizona: White River, White Mountains, June 14, 1934 (M. and H. James).

MALE (*A. meliloti*).—Length 5½ mm. Vertex and scutum rather shiny, with moderate-sized, close, punctures, those of scutum better separated than those of

vertex; punctures of abdomen nearly as coarse as those of dorsum of thorax, though not so close; lateral teeth at apex of abdomen nearly as long as basal width; median teeth quite long, though not twice as long as basal width, and rather slender.

New Mexico: Albuquerque, June 2, 1911. Arizona: Congress (Osler).

Specimens reported as *A. cactorum* from Florissant, Colorado, are *A. californica florissantensis* (Michener).

***Ashmeadiella cactorum aridula* (Cockerell)**

Figures 3 and 4

MALE.—Length  $4\frac{1}{2}$  to  $5\frac{1}{2}$  mm. Antennae nearly black, or flagellum dusky red, beneath; facial line about as long as transfacial; entire face covered with pale hair, but that on clypeus and sides of face most conspicuous. Vertex and scutum shiny with moderate-sized punctures, fairly close on vertex, a little more distinctly separated on scutum; punctures of abdomen about the same size, finer on dorsum of first two or three tergites. Tegulae usually testaceous, but sometimes piceous or even black. Apical teeth of abdomen black, the lateral ones slender and pointed, the median ones nearly twice as long as basal width, somewhat variable.

FEMALE.—Similar to male; facial line longer than transfacial; pubescence of face not so dense, most conspicuous on sides of face; anterior margin of clypeus truncate. Punctures of scutum rather coarse, somewhat better separated than those of vertex; punctures of dorsum of second and third tergites a little smaller than those of vertex, well separated.

California: Altadena, San Gabriel Canyon, Crystal Lake, all in Los Angeles County; Murrieta; Idyllwild, San Jacinto Mountains. Dates for the above localities range from May 13 to August 16. Flower records are as follows: *Heliotropium curassavicum*, *Aster*, *Eriogonum fasciculatum*, and *Lotus* (all Michener, coll.). Herkey Creek (San Jacinto Mountains), California, June 24, on *Lotus* (Cockerell).

In one male the median apical teeth of the abdomen are much shorter than usual. I believe this is an abnormal specimen, because the two teeth are themselves of different lengths and differently shaped,

This form is distinguished from *A. cactorum cactorum* in the female by the less shiny and more finely punctate upper part of the clypeus, smaller size, usually paler tegulae, more coarsely punctate center of scutum, and reduced hair spots at anterior edge of scutum. The males are usually distinguishable by the average size and color of the tegulae.

***Ashmeadiella floridana* (Robertson)**

Two males and a female of this species are from Southern Pines, North Carolina, June 29, 1918 (the female in pink pulse). The female agrees with Robertson's description except that the head is not as large as one would imagine, and the hair between antennae, on clypeus, and

on scutellum, and the scopa are somewhat yellowish. The appearance is similar to *Alcidamea producta* Cresson as stated by Robertson.

**FEMALE.**—Facial line somewhat shorter than transfacial; under side of flagellum somewhat brownish; clypeus somewhat shining, with rather large close punctures; supraclypeal area dull and finely punctate in contrast to clypeus and front; punctures of vertex and scutum about the same size, fairly large; punctures of dorsal middle of second tergite considerably finer and sparser than those of dorsum of thorax.

**MALE.**—Similar to female; pubescence more abundant, but clypeus without much hair; clypeus duller, its punctures finer and closer; punctures of vertex somewhat coarser than those of scutum; punctures of dorsum of abdomen only a little finer than those of scutum; median apical teeth of abdomen subtruncate, broad, not very much longer than basal width.

In both sexes the dull supraclypeal area is distinctive, though it is sometimes difficult to see because of the pubescence.

#### *Ashmeadiella californica californica* (Ashmead)

**FEMALE.**—Length 5 to nearly 7 mm. Facial line slightly longer than transfacial; eyes nearly parallel within; clypeus truncate as usual in the genus; vertex and scutum somewhat shining, with moderate-sized punctures, which are close on vertex, somewhat sparser and larger in center of scutum; front duller, with very close punctures; clypeus with coarser, somewhat elongated, close punctures; abdomen with fine and rather sparse punctures on dorsal parts of first three tergites, those of third tergite coarser than those of second; tegulae black.

**MALE.**—Length nearly 5 to 6½ mm. Face mostly covered with pubescence; punctures of vertex and scutum about the same size, but those of scutum sparser; punctures of sides and posterior parts of abdomen not so coarse as in the female; lateral teeth at apex of abdomen rather broad and pointed; median teeth long, considerably widened basally, nearly twice as long as basal width. (Apex of abdomen similar to that of *A. haematopoda* Cockerell, but lateral teeth somewhat broader and median teeth broader at bases.)

This species, particularly in the female, is quite variable, some specimens being robust with large heads, others comparatively slender. The pubescence is sometimes bright ochraceous, but in other specimens it shows only a faint yellowish tint. However, I am quite certain that there is only one species concerned.

California: Eagle Rock Hills, Altadena, Pasadena, all in Los Angeles County; Mineral King, Tulare County; Tokopah Valley, Sequoia National Park; Murrieta; Mill Creek, San Bernardino Mountains. Dates range from April 14 to September 13. Flower records are *Rhamnus crocea*, *Septanomeria*, and two species of *Aster*. (All the above were collected by the author.) Santa Clara County, July 11 (W. M. Giffard). Niles Canyon, July 16 (W. M. Giffard). Placer County, 6600 feet elevation, August 24, 1916 (W. M. Giffard). Encinitas, June 28 (Cockerell).

*Ashmeadiella californica florissantensis* (Michener)

This form is best considered a subspecies of *californica*. I have seen no Colorado specimens as large as some California specimens, nor have I seen any showing the strongly ochraceous pubescence of many California examples. The best subspecific characters are found in the female (see key). An additional locality is Pingree Park, Larimer County, Colorado, August 22, 1935 (Michener).

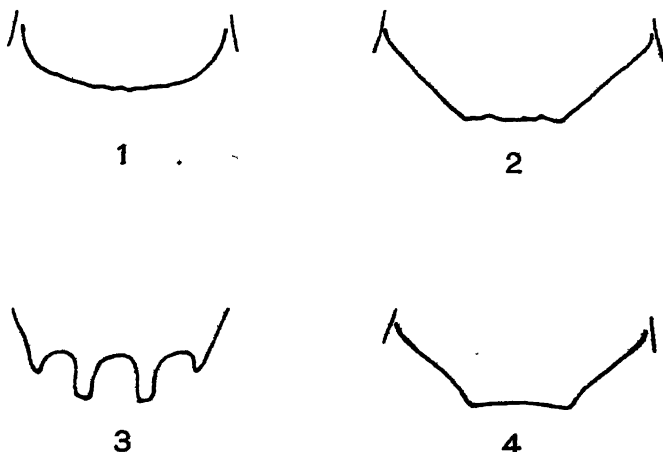


Fig. 1. *Ashmeadiella howardi* (Cockerell), apex of clypeus of female (drawn from the type).

Fig. 2. *Ashmeadiella denticulata* (Cresson), apex of clypeus of female.

Fig. 3. *Ashmeadiella cactorum aridula* (Cockerell), apex of abdomen of male.

Fig. 4. *Ashmeadiella cactorum aridula* (Cockerell), apex of clypeus of female.

Keys to the Species of *Ashmeadiella*

In these keys it has not been possible to include all the described species, but all the species known to me have been included, and as many additional ones as possible. Species marked by an asterisk are unknown to me. In noting the position of the ocelli with respect to the bases of the antennae and the posterior margin of vertex, the head should be viewed from the side.

## FEMALES

- 1.—Apex of clypeus trilobed, the medial lobe largest and notched or toothed....2.
- Apex of clypeus with a median tooth.....*australis* (Cockerell).
- Clypeus largely impunctate and polished, its anterior margin crenulate; mandibles broad.....21.

- Clypeus not much modified. .... 3.
- 2.—Abdomen with much red; facial line considerably longer than transfacial.  
*timberlakei* Michener.  
Abdomen black; facial line only a little longer than transfacial.  
*clypeodentata* Michener.
- 3.—Legs partly red, the abdomen black; desert species with much pale pubescence. 4.  
Legs black (or the tarsi sometimes reddish), or if abdomen is partly red, the legs may be partly red; pubescence usually less conspicuous. .... 6.
- 4.—Legs entirely red except for the coxae; clypeus rather dull.  
*haematopoda* Cockerell.  
Fore and middle legs partly suffused with black, the fore legs sometimes entirely black. .... 5.
- 5.—Clypeus shining, with large punctures.  
*bigeloviae* (Cockerell) (= ? *rufipes* Titus).  
Clypeus dullish, with smaller punctures. .... *rhodopus* Michener.
- 6.—Apex of clypeus broadly rounded, slightly crenulate, the apical margin very broadly somewhat shining; red present on abdomen, but not on legs.  
*howardi* Cockerell.  
Apex of clypeus truncate, the truncation sometimes slightly concave or undulate. .... 7.
- 7.—Punctures of apical part of clypeus very dense and small, this region distinctly duller than rest of clypeus; truncation of clypeus concave. .... 8.  
Apical part of clypeus not duller than the rest of clypeus, the extreme apical margin impunctate. .... 9.
- 8.—Red on abdomen and hind legs. .... *basalis basalis* Michener.  
Abdomen and hind legs black. .... *basalis nigra* Michener.
- 9.—Face unusually broad, the length of an eye being about equal to the greatest distance between the eyes; large robust form. .... *maxima* Michener.  
Face not so broad, the length of an eye greater than distance between eyes; usually smaller or less robust species. .... 10.
- 10.—Dorsum of head and thorax dull, finely and closely punctate. (*A. schwarzi* Titus, only 5 mm. long, is the duller of the other group and the only one that might make confusion here.) .... *echinocerei* Cockerell.  
Dorsum of thorax shiny and more coarsely punctate. .... 11.
- 11.—Supraclypeal area dull and finely punctate in contrast to front and clypeus.  
*floridana* (Robertson).  
Supraclypeal area punctured in about the same way as clypeus or front. .... 12.
- 12.—Small joints of tarsi ferruginous; abdominal bands pale yellowish; pubescence abundant. .... *leucozona* Cockerell.  
Small joints of tarsi black, or the claw joints sometimes rufescent. .... 13.
- 13.—Punctuation of abdomen very fine and sparse, the punctures of dorsum of second tergite much smaller than those of scutum. [See also *A. prosopidis* (Cockerell) which is only 5 mm. long, and some specimens of *A. coloradensis* Cockerell.] .... 14.  
Punctuation of abdomen not very much finer than that of scutum. [I have one *A. californica californica* (Ashmead) which would best fall in this group.] .... 15.

- 14.—Clypeus with large punctures, usually separated by shiny ground.

*californica florissantensis* (Michener).

Clypeus with smaller, close punctures. . . . *californica californica* (Ashmead).

- 15.—Distance from anterior ocellus to posterior edge of vertex greater than distance from anterior ocellus to antennal sockets; coarsely punctate species; abdomen rather long and parallel sided; anterior margin of clypeus usually with a slight notch on each side of the middle. (See *A. coquillettii* Titus). . . 16.

Distance from anterior ocellus to posterior edge of vertex equal to or less than distance from anterior ocellus to antennal sockets; abdomen not usually so parallel sided; anterior margin of clypeus not so notched. . . 17.

- 16.—Punctures of cheeks coarser than those of pleura. . . . . *bucconis* (Say).  
Punctures of cheeks finer and sparser than those of pleura.

*denticulata* (Cresson) [= *rotundiceps* (Cresson), *wislizeni* Cockerell].

- 17.—Robust large-headed form; twice distance from posterior ocelli to posterior edge of vertex considerably greater than distance from posterior ocelli to antennal sockets. (More robust and more finely punctate than *denticulata* or *bucconis*). . . . . *coquillettii* Titus.

More slender species; twice distance from posterior ocelli to posterior edge of vertex about equal to distance from posterior ocelli to antennal sockets. . . 18.

- 18.—Facial line considerably longer than transfacial; punctures of abdomen considerably smaller than those of thorax. . . . . *prosopidis* (Cockerell).

Facial line but little (if any) longer than transfacial; punctures of abdomen less conspicuously smaller than those of thorax. . . . . 19.

- 19.—Head and thorax rather finely punctate, the abdomen but little more finely so; very small species. . . . . *schwarzii* Titus.

Head and thorax more coarsely punctate, the contrast between punctation of thorax and abdomen more conspicuous. . . . . 20.

- 20.—Pleura quite finely and rather closely punctate, usually a little more finely so than cheeks; practically no spots of pubescence at anterior edge of scutum; abdomen sometimes partly red, usually more finely and sparsely punctate than in forms of *cactorum*; clypeus about as in *A. cactorum aridula*.

*coloradensis* Cockerell.

Pleura a little more coarsely punctate; inconspicuous spots of pubescence at anterior edge of scutum; clypeus moderately closely punctate, not strongly shiny. . . . . *cactorum aridula* (Cockerell).

Pleura a little more coarsely punctate than in either of the above; clypeus above with rather large punctures, separated by shiny ground; anterior edge of scutum with a pair of well-developed hair-spots.

*cactorum cactorum* (Cockerell) (= *meliloti* Cockerell).

- 21.—Anterior margin of clypeus with a deep median emargination.

*Titusella cubiceps* (Cresson) (= *primitus* Cockerell).

Anterior margin of clypeus without a deep emargination.

*T. clypeata* Michener.

#### MALES

- 1.—Abdomen black (sometimes brownish at extreme sides); legs partly red. . . . 2.

Abdomen black (sometimes brownish at extreme sides); legs dark brown or black (or the tarsi sometimes reddish); or abdomen with red, the legs with or without red. . . . . 4.



- 2.—Legs entirely red; median apical teeth of abdomen more than twice as long as basal width. . . . . *haematopoda* Cockerell.  
For legs and middle legs beyond the femora black or suffused with black. . . . . 3.
- 3.—Median teeth at apex of abdomen nearly twice as long as basal width, black. . . . . *rhodopus* Michener.  
Median teeth at apex of abdomen about one and one-half times as long as basal width or a little shorter, usually translucent. . . . . *bigeloviae* (Cockerell) (= ? *rufipes* Titus).
- 4.—Abdomen nearly all red. . . . . *\*holtii* Cockerell.  
Abdomen black or only partly red. . . . . 5.
- 5.—Lateral teeth at apex of abdomen very broad, the apex nearly a right angle, the lateral edges of sixth tergite strongly convex; abdomen with red. . . . . 6.  
Lateral teeth at apex of abdomen narrower and acutely pointed, the sides of sixth tergite only slightly convex. . . . . 8.
- 6.—Hind femora black. . . . . *howardi* Cockerell.  
Hind femora with red. . . . . 7.
- 7.—Red markings bright; outer teeth at apex of abdomen red. . . . . *timberlakei* Michener.  
Red markings very dark; outer teeth at apex of abdomen black; abdomen more finely punctate than in the above. . . . . *lateralis* Michener.
- 8.—Abdomen with red. . . . . 9.  
Abdomen black or nearly so. . . . . 10.
- 9.—Clypeus, except apically, with rather large punctures; bases of hind femora red; red of abdomen confined to first tergite and extreme sides of second. . . . . *basalis basalis* Michener.  
Clypeus dull with minute close punctures; red variable, but so far as I have seen not as in *basalis*. . . . . *coloradensis* Cockerell.
- 10.—Median apical teeth of abdomen long and usually slender apically, at least one and one-half times as long as basal width except in a few species where the bases of the teeth are broadened. (In *A. altadenae* Michener these teeth are broad for their entire length, but in the other species the apical parts of the teeth are narrow, rather parallel-sided, and the apices are subtruncate.) . . . . . 11.  
Median teeth of apex of abdomen short and rather broad, less than one and one-half times as long as basal width. (In this group these teeth may be triangular in outline and pointed at apices, or rather parallel-sided and subtruncate at apices, but in no case are they narrow with subparallel sides apically as in most of the above group.) . . . . . 19.
- 11.—Median apical teeth of abdomen broad, separated at their apices by less than twice the apical width of one of them, small species. . . . . *altadenae* Michener.  
Median apical teeth of abdomen narrow, separated at their apices by much more than twice the apical width of one of them. . . . . 12.
- 12.—Dorsum of second tergite much more finely punctate than scutum. . . . . 13.  
Dorsum of second tergite not very much, if any, more finely punctate than scutum. . . . . 14.
- 13.—Clypeus shiny with large punctures; sides of second tergite with larger punctures. . . . . *californica florissantis* (Michener).

Clypeus duller with smaller punctures; sides of second tergite duller.

- californica californica* (Ashmead).  
 14.—Punctures of dorsum of abdomen coarser than those of scutum; legs dark brown.....*arizonensis* Michener.  
 Punctures of dorsum of second tergite the same size or smaller than those of scutum.....15.  
 15.—Length 7 mm. or more.....16.  
 Length less than 6 mm.....18.  
 16.—Clypeus more coarsely punctate; slender species; facial line about equal to transfacial.....*opuntiae* (Cockerell).  
 Clypeus more finely punctate; robust species; face wider.....17.  
 17.—Scutum rather shiny, its punctures like those of vertex.....*maxima* Michener.  
 Scutum a little duller, its punctures somewhat finer than those of vertex.....*submaxima* Michener.  
 18.—Usually larger; tegulae usually black.  
*cactorum cactorum* (Cockerell) (= *meliloti* Cockerell).  
 Usually smaller; tegulae usually testaceous.....*cactorum aridula* (Cockerell).  
 19.—Apical teeth of abdomen light clear red, the median ones short and broad; pubescence abundant; small joints of tarsi ferruginous.  
*leucozona* Cockerell.  
 Apical teeth of abdomen black or dark red; pubescence less abundant; small joints of tarsi black except sometimes for claw joints.....20.  
 20.—Twice distance from posterior ocelli to posterior edge of vertex considerably greater than distance from posterior ocelli to antennal sockets; coarsely punctate species.....21.  
 Twice distance from posterior ocelli to posterior edge of vertex hardly if any greater than distance from posterior ocelli to antennal sockets; more finely punctate.....22.  
 21.—Wings quite dusky; very coarsely punctate species.....*bucconis* (Say).  
 Wings paler brownish gray; a little less coarsely punctate form.  
*denticulata* (Cresson) (= *rotundiceps* (Cresson), *wishizeni* Cockerell).  
 22.—Scutum dullish with small close punctures.....*curriei* Titus.  
 Scutum shiny, with larger, well-separated, punctures.....23.  
 23.—Punctures of vertex coarser than those of scutum.....24.  
 Punctures of vertex about the same size as, or a very little smaller than, those of posterior part of scutum.....25.  
 24.—About 5 mm. long; median apical teeth separated by about twice the basal width of one of them.....*basalis nigra* Michener.  
 About 8 mm. long; median apical teeth separated by about the basal width of one of them.....*floridana* (Robertson).  
 25.—Punctures of anterior part of scutum very fine compared with those of vertex or rest of scutum; pubescence rather sparse.....*cockerelli* Michener.  
 Punctures of anterior part of scutum but little finer than those of disk of scutum; pubescence rather abundant. (One abnormal *A. cactorum aridula* (Cockerell) would run to this point.).....*coloradensis* Cockerell.

The following apparently valid species have been described but are omitted from the keys:

*microsoma* Cockerell (Mexico)

*digiticauda* Cockerell (Mexico)

*rhodognatha* Cockerell (Mexico)

*subangusta* Cockerell (Mexico)

*crassa* Cockerell (Mexico). Mr. Timberlake states that Cockerell's California record of this species (1925) apparently refers to *californica* (Ashmead), although true *crassa* from Mexico is distinct.

male *schwarzi* Titus (Arizona and Mexico)

male *coquilletti* Titus (California)

female *curriei* Titus (British Columbia and Washington)

*gillettei* Titus (Colorado)

female *opuntiae* (Cockerell) (New Mexico and California)

*bequaerti* Cockerell (Yucatan)

*lutzi* (Cockerell) (Colorado). Described as *Chelostomopsis* but probably an *Ashmeadiella*.

#### MONUMETHA

##### *Monumetha albifrons* (Kirby)

Gull Lake, Mono County, California, July 11, 1934 (Mrs. J. E. Law);  
Crabtree Meadow, Tulare County, California, July 20, 1935 (Evans).

##### *Monumetha maura* (Cresson)

The eyes of the female diverge below, indicating that this is a *Monumetha*, not an *Osmia* as originally described. Unfortunately the male is unknown.

Altadena, California, May 12 to June 11, on *Godetia* and *Phacelia tanacetifolia*; Mill Creek, San Bernardino Mountains, California, May 30, 1931; Big Bear Lake, San Bernardino Mountains, California, July 26, 1934 (Michener). The last specimen chewed a piece of a leaf of a small herbaceous plant into a pulp and started to fly away with it. (See notes on *Osmia pellax* Sandhouse, Jour. Econ. Ent., XXVIII, August, 1935.)

#### ROBERTSONELLA

##### *Robertsonella gleasoni* Titus

Several specimens of both sexes from Fedor and from Lee County, Texas (Birkmann), are referable to this species. One male is large, as in *R. crataegina* Cockerell, which is evidently a synonym of *gleasoni*. The venation is variable, and cannot be used to separate the species.

#### ALCIDAMEA

##### *Alcidamea producta* Cresson

One male from Boulder, Colorado, June 14, 1933 (M. and H. James) has testaceous tegulae, like the Californian *A. grinnelli* Cockerell.

However, the punctures of the scutum are as in *producta*. Numerous other specimens of *producta* from the same locality and from other parts of Colorado are normal.

#### OSMIA

##### *Osmia cobaltina* Cresson and *Osmia bruneri* Cockerell

The distinctions pointed out in keys by Sandhouse (1924) and Cockerell (1928) to distinguish female *O. cobaltina* from *bruneri* will not hold. Those of Sandhouse hold usually, but a decidedly purplish female from Boulder, Colorado (Thompson), has the hair of clypeus as long as in most *bruneri*, and the lower part of face not purple. Prof. Cockerell's distinction, based on the color of the hair of the propodeum, is apparently an error. *O. cobaltina* usually has a few dark hairs on lower part of posterior face of propodum, while *bruneri* does not. If the series is divided by length of clypeal hairs, it divides nicely in one place. If the color of the scutum is used, the division point is in quite a different place. The hairs of the propodeum and the color of the abdomen are similarly unsatisfactory. On the basis of the females, then, I think *bruneri* is a variety of *O. cobaltina*.

The apparent difficulty lies in the males. A gynandromorphic specimen from Troublesome, Colorado (Rohwer), normal males from Gold Hill (M. T. James), Princeton Hot Springs (Chas. Wagner), Boulder, Ward, and Elbert (Lutz), all in Colorado, and Craters of the Moon, Idaho (Louise Ireland), are apparently *O. cobaltina* or *bruneri* (all are green). Yet a male supposed to be *O. cobaltina* from Mount Wilson, Los Angeles County, California (F. Grinnell, Jr.), is certainly a different species. I now believe that this specimen is the male of *O. kermesina* Sandhouse. This specimen and the gynandromorph have made it entirely impossible to determine male *cobaltina* or *bruneri* from any key. It appears that the Mount Wilson specimen is the basis for male *cobaltina* in the Sandhouse keys, while the statement in Cockerell's key that male *bruneri* has the hair of vertex entirely black is based on the gynandromorph. Therefore I give notes on each species, as follows:

##### *Osmia cobaltina* Cresson

The male is *O. bella* Cresson.

##### *Osmia cobaltina bruneri* (Cockerell)

The male is *O. bennettiae* Cockerell.

In the males, both forms are bright green. They do not differ structurally, unless the genitalia are found to be different. A male from

Ward, Colorado, bred by C. H. Hicks, from the same lot with a female *bruneri* has a few black hairs on the vertex, thus being somewhat intermediate between the two forms. The male *cobaltina* from Idaho, referred to above, has the posterior margins of the tergites purple.

Three female *Osmia* from Big Bear Lake and Bluff Lake, both in the San Bernardino Mountains, California, two on *Potentilla bolanderi* var. *bernardina*, July 15, 1935 (Michener), are apparently *O. cobaltina*, but the pubescence of the thorax is unusually short, perhaps due to wear.

#### *Osmia kermesina* Sandhouse

MALE.—Rich purple, including tegulae and legs except the tarsi (hind basitarsi purple); the scutum slightly bluer; the face around antennae and at sides greenish blue; the abdomen rather reddish purple, the apical margins of the tergites concolorous. Pubescence black (that of pleura, cheeks, and fore legs a little reddish, or quite pale in certain lights), except that of face, vertex, and dorsum of thorax; hair of face white with black intermixed, especially around antennae and sides of face; vertex black-haired, except for a few pale hairs around posterior margin and ocelli; scutum and scutellum pale-haired, with some black intermixed, especially on scutellum. Sixth tergite with a very minute notch; seventh bidentate; scutum finely and closely punctate.

It is possible that this is *O. basilissa* Cockerell but, in the females which I have examined, the basal vein nearly meets the transverse median in *basilissa*, while in *kermesina* the basal vein is a little based to the transverse median. On this character, the male falls with *kermesina*. The chief difference between the two species, in the females, is the punctuation of the scutum. The distinction used by Sandhouse, based on the color of the tegulae, does not hold, since all the specimens of *basilissa* seen by me (including one determined by Sandhouse) have the tegulae entirely metallic. *O. kermesina* varies from purple to bluish green. *O. basilissa* varies from purple to bluish purple.

#### *Osmia holochlora* Cockerell

A male from Boulder, Colorado, at flowers of *Besseyia plantaginea*, May 15, 1908 (Rohwer), is apparently this species. It is most readily distinguished from *cobaltina* Cresson by the large notch of the sixth tergite and the lack of dark hair on head and thorax. A female from Boulder, June 9, 1905 (W. P. Cockerell), is probably this form. It is brilliant green, bluer than the male, but not blue. It resembles *O. cobaltina bruneri* but the hair of the pleura is white (various shades of fuscous, nearly black to quite pale, in *cobaltina*); the abdomen is smoother; the clypeus, viewed from in front, has the truncation shorter than the distance from end of truncation to eye margin (in *cobaltina*

the truncation is longer than the distance from its end to eye margin, if viewed from directly in front but, if seen from obliquely above, the truncation appears short as in *O. holochlora*). This is the specimen which Cockerell suggested might be *O. bella* female, but he later changed this opinion, referring it provisionally to *O. cobaltina*.

***Osmia ribifloris biedermannii*, new subspecies**

FEMALE (type).—Similar to typical *O. ribifloris* but green, the clypeus sometimes somewhat bluish; pubescence mostly black, but somewhat mixed with and on lower part of face practically replaced by pale fuscous.

MALE.—Green, the same color as the female; pubescence similar to that of male *O. lignaria* Say. The two are easily distinguished, of course, by the greener color and green legs of *ribifloris*.

Altadena, California (type locality), February 2, 3, and 16, 1935, on *Buddleia* and *Cryptanthus*; Arroyo Seco, Los Angeles County, California, January 27, 1935, and Pasadena, California, March 13, 1931, on *Ribes* (all Michener, coll.). Seventeen specimens show no intergradations toward the blue New Mexican form. Titus named this *O. biedermannii*, from Arizona specimens, two of which I have seen in the Cockerell collection. However, he has never published the name and is no longer working on bees.

***Osmia parallela*, new species**

MALE.—Length  $11\frac{1}{2}$  mm.; form slender; abdomen parallel-sided. Head and top of thorax rather dull green, pleura, propodeum, and first tergite bluer and a little more shiny, rest of abdomen steel blue and quite shiny, the apical margins of the tergites concolorous; mandibles black, both teeth pointed; apex of clypeus black, the edge minutely sinuate; antennae black; tegulae black, green at anterior ends, legs black, the fore and hind femora bluish, the tibiae hardly greenish, the claw joints of the tarsi rufescent. Punctuation of head and top of thorax fine and dense; pleura more coarsely and sparsely punctate, shining between the punctures; scutellum more coarsely punctate, especially medially, than scutum; enclosure of propodeum dull, the upper half longitudinally striate. Hair of head and thorax long and dense, pale ochraceous; white on clypeus; mixed with black on cheeks and posterior part of pleura; replaced by black on sides of propodeum, and by pale fuscous on vertex; hair of mandibles mostly black; hair of middle and hind legs black; small joints of tarsi with appressed white pubescence; fore femora with fringes of long white hair posteriorly; fore tarsi with white hair, longer black ones being intermixed; fore tibiae black-haired, with white hairs intermixed; pubescence of abdomen black except for a few pale hairs on last tergite and long pale hairs on first tergite. Middle tarsi normal; hind basitarsi with a small tooth. Wings slightly grayish, the basal vein meeting the transverse median, second abscissa of cubital vein longer than fourth, both quite long. Sixth tergite of abdomen with a rather small but deep semi-circular notch; seventh bidentate; venter of abdomen normal.

La Crescenta, California (type locality), on *Salvia mellifera*, April 20, 1935 (Michener); Eagle Rock Hills, Los Angeles County, on *Salvia mellifera*, April 14, 1933 (Michener); Aliso Canyon, Los Angeles County, California, May 10, 1933 (Michener). The latter locality is on the edge of the desert.

This is a more slender species than *O. integra* Cresson. It apparently is closest to *O. marginipennis* Cresson, *cyaneonitens* Cockerell and *viridior* Cockerell. It differs from the first and third (which are said to be the same) by lack of pale hair on the second and third tergites, and from the second by presence of black hair on cheeks and sides of thorax. Runs to *O. peridonea* Sandhouse in the Sandhouse key to western species, from which it differs by lack of a polished line on scutellum, etc. It is very similar to *O. pseudamala* Cockerell, but differs by the black flagellum, and by the short, entirely black hair of dorsum of second tergite, etc. Differs from *O. seneciophila* Cockerell by the same characters and the deeper notch of the sixth tergite.

#### *Osmia brevior*, new species

FEMALE.—Length nearly 9 mm. Dark blue, the hind margins of the tergites concolorous. Pubescence black, intermixed with a very little white on scutellum and postscutellum, more white on first tergite, and a very little on remaining tergites, particularly second; a tuft of pale hair behind wing bases; cheeks with a little fuscous hair below. (Here and there, there seem to be a few other white hairs, but this is due to reflections on coarse black bristles.) Clypeus normal, the anterior edge black; mandibles black, tridentate, with an additional small tooth between second and third teeth; antennae black; tegulae black, bluish at extreme anterior ends. Punctuation fairly fine and close, but some ground area visible between punctures, especially on posterior part of scutum; scutellum with an ill-formed longitudinal median impunctate line; enclosure of propodeum dull and minutely roughened above, shiny below. Legs black, with black hair except on the first four metatarsi, where it is rufescent. Wings quite dark grayish brown, the basal vein just basad to the transverse median, second abscissa of cubital vein twice length of fourth. Apical impunctate margins of tergites very narrow, absent on first segment.

Altadena, California (type locality), on *Lotus scoparius*, June 11, 1933, and May 12, 1934 (Michener); Big Bear Lake, San Bernardino Mountains, California, July 16, 1934 (Michener); Claremont (Metz).

Runs out at 48 in the Sandhouse key to western species. Differs from *O. visenda* Sandhouse by the much darker tegulae. This species does not have such long hairs on the face as in *O. brevis* Cresson. It differs from *O. nanula* Cockerell by having fewer pale hairs on scutellum, from *O. tristella* Cockerell by presence of pale hair on scutellum, and from *O. cyanella* Cockerell by tuft of pale hairs behind wing bases.

*Osmia cyanosoma* Cockerell

Fairfax, Marin County, California, April 12, 1925 (C. L. Fox); Mill Creek, San Bernardino Mountains, California, May 30, 1931 (Michener); Boulder, Colorado, July 6, 1935 (Michener). The species is new to Colorado.

A male which probably belongs to this species is from La Crescenta, California, on *Salvia mellifera*, May 5, 1935 (Michener). It differs from *O. atriventris* Cresson by the black flagellum, from *O. aprilina atrovirens* Sandhouse by black legs, bluer color, and longer head. It runs to *O. aprilina* Cockerell in the Sandhouse key to Pacific Coast species. Differs from *O. wheeleri* Cockerell by dark legs, etc. It is described as follows:

Length nearly 7 mm. Dark blue green, the face greener; posterior edges of tergites blue, edged apically with purplish brown; legs, tegulae, antennae, and mandibles black; the hind femora very faintly bluish. Anterior edge of clypeus minutely and irregularly dentate, black; hind metatarsi toothed, mid-tarsi and antennae normal. Punctuation of head and thorax fine, close on head, not quite so close on dorsum of thorax, especially sparse in center of scutum, quite coarse on scutellum, which has a rather poorly formed median, impunctate streak; enclosure of propodeum dull. Wings brownish, the basal vein hardly based to the transverse median, the second abscissa of cubital vein distinctly longer than fourth. Hair of head and thorax very long and rather sparse, white on face below antennae, black with a little pale intermixed on vertex, mixed black and pale on cheeks and front; hair of thorax pale, with a faint ochraceous tinge, with numerous long dark hairs on dorsum; hair of mandibles black; hair of legs mixed black and white, the white exceeding or replacing black in many places; hair of first tergite pale, mixed with much black at sides, of second pale on basal half of disk, otherwise mostly dark; hair of rest of abdomen mostly black, a few apparently pale (pale in certain lights, at least) hairs intermixed. Sixth tergite with a small notch, seventh bidentate, but not so strongly bidentate as in many species, the teeth broad and not sharply pointed.

*Osmia trevoris* Cockerell, and its relatives

The females belonging to this species may be separated thus:

- 1.—Hair of sides of propodeum pale; hair of vertex largely pale... *giliarum* Cockerell.  
Hair of sides of propodeum black..... 2.
- 2.—Hair of vertex all black; scutum with a few black hairs..... *trevoris* Cockerell.  
Hair of vertex largely pale; of scutum all pale..... *subtrevoris* Cockerell.

*O. corksini* Sandhouse would run to *subtrevoris* but the scutum is much more coarsely punctured, the hair of front is largely pale, etc.

These are mixed in Cockerell's key (1928). In the type of *subtrevoris* the vertex has white hair, mixed with some black. The same is true of *O. giliarum*. In the description of *giliarum* the sides of the propodeum are definitely stated to have white hair, not black as indicated in Cock-



erell's key. However, Prof. Cockerell later corrected this (1935). In the key referred to, specimens of *O. giliarum* are the basis of *brevis* (of Cockerell, not of Cresson). I have not seen authentic *O. trevoris*, but I believe my identification is correct. Localities for females are as follows:

***Osmia trevoris* Cockerell**

Florissant, Colorado, June 31, 1908 (Rohwer); Garberville, Humboldt County, California, April 19, 1935 (Van Duzee).

***Osmia trevoris* variety *subtrevoris* (Cockerell)**

Florissant, Colorado, as previously recorded by Prof. Cockerell; Elbert, Colorado, June 3, 1934 (Figgins); near Parker, Colorado, May 11, on *Pentstemon* (Figgins); Jackson, Wyoming, 6300 feet elevation, 43° 30' N., 110° 46' W. (Mrs. F. E. Lutz); Pasco, Washington, May 25, 1896.

***Osmia trevoris* variety *giliarum* (Cockerell)**

Florissant, Colorado [recorded as *O. wilmattae* Cockerell variety *a* (1912)]; Tolland, Colorado (Robbins); Elbert, Colorado (as recorded by Cockerell); near Parker, Colorado, May 11, on *Pentstemon* (Figgins).

The color of the pubescence of the scutellum is probably not of value in this group. It may be that in a single individual this pubescence changes from ochraceous to white in the course of the lifetime. *O. seneciophila* Cockerell is apparently the male of *O. trevoris subtrevoris* (Cockerell). One male from the top of Las Vegas Range, New Mexico (Cockerell) has a little black hair on the pleura.

***Osmia corkinsi* Sandhouse**

Boulder, Colorado, 5600 feet elevation, May 27-28, 1922 (F. E. Lutz); Camp Roosevelt, Yellowstone Park, Wyoming, July 14-17, 1923.

***Osmia hendersoni* Cockerell**

Two from Mount Putnam, near Blackfoot, Idaho, July 26, 1934 (Louise Ireland), are nearly 9 mm. long. One has the hair of sides of propodeum white. In the other it is black, as described. Another specimen [the *O. wilmattae* Cockerell variety *b* (1912)] has white hair on sides of propodeum. The latter specimen has the black areas of typical *hendersoni* bluish in some lights, and is more slender than the Idaho specimens. Specimens having white hair on sides of propodeum run to *O. grindeliae* Cockerell in Cockerell's key (1928). In the latter species, the punctures of scutum are not quite as close as they could be, while

in *hendersoni* they are as close as possible over most of the surface. In all these *hendersoni* the basal vein is basad to the transverse median.

***Osmia chalybea* Smith**

A female from Edna, Texas (Bishopp), and a male from Louisiana (Morrison) are in the Cockerell collection. The species is easily known by the very dark brown wings. The male had been determined by someone (not Prof. Cockerell) as *O. marginipennis* Cresson, and is the cause for the statement in Cockerell's key (1928) that *marginipennis* has blue legs. A specimen of *marginipennis* from Wawawai, Washington, April 24, 1909, (det. Sandhouse) has black legs as described by Cresson.

***Osmia caulicola* Cockerell**

Hubbard Ranch, near Elbert, Colorado, on flowers of *Gilia calcarea*, June 3 (Figgins); Elbert, Colorado, 7400 feet elevation, June 9-11, 1922 (F. E. Lutz); Stewart Ranger Station, Wyoming, 6700 feet elevation, 43° 42' N., 110° 45' W. (Mrs. F. E. Lutz).

The female runs to *O. phaceliae* Cockerell in Cockerell's table (1928). It differs from that species by the more coarsely punctate abdomen, which is short and globose. The pubescence of the two species is quite similar. *O. caulicola* has more black hair on the scutum than one would judge from the description. The pale pubescence of the above recorded specimens is nearly white, not ochraceous as in the types, which were bred specimens. In all the females (including the type) the hind femora are faintly greenish, not black as described. A male from Wyoming is bluer than the cotype male, and has more brown on the under side of the flagellum. The channel down the front in the female is a variable character. It is present in some specimens of both *O. phaceliae* and *O. caulicola*. *O. caulicola* resembles *O. biogastra* Cockerell, but in the latter species the clypeus is pale-haired.

***Osmia brevis* Cresson**

Jim Creek, near Boulder, Colorado, 6400 feet elevation, June 21-23, 1922 (F. E. Lutz, at blue *Pentstemon*); Ward, Colorado, 9000 feet elevation, July 3, 1922 (G. W. Strawbridge); Claremont, California (Metz); Pasadena, California (Michener), April 1, 1931, and May 12, 1934, the latter on *Pentstemon spectabilis*; Eagle Rock Hills, Los Angeles County, California, May 27, 1933 (Michener), on *Lotus scoparius*; Gull Lake, Mono County, California, July 11, 1934 (Mrs. J. E. Law).

***Osmia cerasi* Cockerell**

Roggen, Colorado, May 8, 1934.

***Osmia nassa* Cockerell**

Claremont, California (Metz); San Gabriel Canyon, Los Angeles County, California, June 17, 1933 (Michener); Big Bear Lake, San Bernardino County, California, July 15, 1934 (Michener).

***Osmia clarescens* Cockerell**

Claremont, California (Metz). This is a common species in Pasadena, California. Dates range from March 3 to April 29. I also have the species from La Crescenta, from Altadena, and from Puddingstone Canyon in the San Jose Hills, all in Los Angeles County, California (all Michener, coll.).

***Osmia wardiana* Cockerell**

Longs Peak, Colorado, about 9000 feet elevation, June 14-19, 1922 (F. B. Lutz).

***Osmia pentstemonis* Cockerell**

Mineral King, Tulare County, California, September 3, 1933, on *Aster* (Michener); Ward, Colorado, 9000 to 9300 feet elevation, June 3 and June 25, 1922 (F. E. Lutz); Elbert, Colorado, 7400 feet elevation, June 9-11, 1922 (F. E. Lutz). One male has the antennae slightly brownish beneath.

***Osmia armaticeps* Cresson**

Ward, Colorado, 9300 feet elevation, June 25, 1922 (F. E. Lutz and F. B. Lutz, at dandelion).

The male *O. armaticeps* of Cockerell's key (1928) is evidently *O. amala* Cockerell. It differs from typical *amala* by the faintly greenish hind femora, but the difference is so slight as to be negligible.

Another male in the Cockerell collection labeled *O. armaticeps* is similar to *O. cyaneopitens* Cockerell but the seventh tergite is produced with a narrow notch. Perhaps this is another species, and *cyaneopitens* is the male *armaticeps*.

***Osmia cyaneopitens* Cockerell**

Jim Creek, near Boulder, Colorado, about 6400 feet elevation, June 21-23, 1922 (F. E. Lutz, at blue *Pentstemon*).

***Osmia besséyae* Cockerell**

Ward, Colorado, 9300 feet elevation, June 25, 1922 (F. E. Lutz); Longs Peak Inn, Colorado, 9000 feet elevation, June 15, 1922 (F. E. Lutz). These are about  $6\frac{1}{2}$  mm. long.

*Osmia coloradella* Cockerell

Boulder, Colorado, 5500 feet elevation, May 24-25, 1922 (F. E. Lutz, at a legume and at *Pentstemon*). One of these is 11 mm. long, and hence runs to *O. densa* Cresson in Cockerell's key (1928).

*Osmia longula* Cresson

Ward, Colorado, 9300 feet elevation, June 25, 1922 (F. E. Lutz); east of Parker, Colorado, on *Pentstemon*, June 9 (Figgins). A specimen from the latter locality has a little green at the anterior end of tegulae.

*Osmia albolateralis* Cockerell

Boulder, Colorado, June (Norma LeVeque). This and a specimen from Eldora, Colorado (Cockerell), have the abdomen much bluer than in the type. The type has a few black hairs on front, scutum, and scutellum, very few on scutum. These were not mentioned in the original description.

*Osmia lutzii*, new species

FEMALE.—Length nearly 9 mm.; dark blue-green, the posterior edges of tergites concolorous and only very narrowly impunctate, the scutum dull in some lights, the clypeus and pleura blackish; antennae, mandibles, tegulae, and legs black, the tegulae with a brown spot; mandibles tridentate, with no indication of a fourth tooth; anterior margin of clypeus slightly emarginate; head and thorax finely and closely punctate, the scutum, except posteriorly, very finely punctate; scutellum with a polished streak; pubescence of head and thorax pale, the clypeus with much black hair, the vertex with much black intermixed, the rest of face and cheeks with some black intermixed; scutum with a very few dark hairs, easily overlooked; pubescence of legs black except for that of fore femora, which is largely white, and that of under sides of tarsi, which is rufescent or fulvous; wings brownish, the basal vein slightly distad to the transverse cubital, the second abscissa of cubital vein longer than fourth; pubescence of abdomen predominantly black, but hairs of first tergite all white; second, third, and fourth tergites with white hairs at apices, second with some pale hair at base; sixth tergite with appressed pale hairs among the black; scopa black.

Jackson, Wyoming, July 13-17, 1920, about 43°, 30' N., 110° 16' W., elevation 6300 feet (Mrs. F. E. Lutz).

This species is related to *O. pellax* Sandhouse; but there is much less black hair in *O. lutzii*. The apical impunctate edges of the tergites are broad in *pellax*, almost wanting in *lutzii*. Otherwise the two species are very similar in structure. Another species with a very finely punctate scutum is *O. sedula* Sandhouse, which has quadridentate mandibles. *O. mertensiae* Cockerell also has quadridentate mandibles.

*Osmia pellax* Sandhouse

Gull Lake, Mono County, California, July 11, 1934 (Mrs. J. E. Law).

*Osmia coloradensis* Cresson

MALE.—Length  $8\frac{1}{2}$  to 9 mm.; blue to greenish blue, similar to the female; clypeus normal; antennae black; tegulae blue in front, black behind; fore and hind femora blue; hind tibiae sometimes very faintly metallic; hind metatarsus with a large tooth within; sixth tergite with a shallow notch, seventh bidentate; posterior margins of tergites slightly bluer (less green) than rest of abdomen; entire body rather finely and densely punctate, the scutellum without an impunctate streak; enclosure of propodeum shiny below, dull and rough above; stipites with few short hairs.

Runs to *O. eutrichosa* Cockerell in the Sandhouse keys (1924 and 1925) and to *O. ramaleyi* Cockerell in Cockerell's key (1928).

The hind femora of the female are sometimes faintly metallic, more often black. The females vary from blue to blue-green, and in one specimen the scutum is blackish in many lights.

California: Florence Lake, Fresno County, July, 1931; Tokopah Valley, Sequoia National Park, August 25, 1933, on *Rudbeckia californica*; Pasadena, March 17 to May 1; San Diego, April 1, 1934 (all Michener, collector).

*Osmia (Acanthosmioides) nifoata* Cockerell

I have seen a cotype of this species, and another specimen from Fox Park, Wyoming, 9100 feet elevation,  $41^{\circ} 4' N.$ ,  $106^{\circ} 9' W.$ , June 15, 1920 (F. E. Lutz). The distinctions noted by Sandhouse to distinguish *O. nifoata* from *O. sladeni* Sandhouse (of which I have seen a paratype) do not hold. There are a few black hairs on the cheeks of both specimens of *nifoata*. The basal vein meets the transverse median in *sladeni* and in the Wyoming *nifoata*, and is only slightly basad to it in the cotype of *nifoata*.

The hind tibiae are greenish except on apical third in the cotype of *nifoata*, black in the Wyoming specimen. In both *nifoata* and *sladeni* the process of the second sternite is compressed apically, not much widened basally (seen from beneath), with a groove on ventral side. This is doubtless similar to that found in *O. odontogaster* Cockerell.

*Osmia (Acanthosmioides) physariae* Cockerell

One specimen (det. Sandhouse) with same data as the Wyoming *O. nifoata* recorded above. This will run to *nifoata* in Cockerell's key (1928). Perhaps this is incorrectly determined. The fore and hind femora are bluish (described as black); the basal vein is a little distad to the transverse median (description says they meet). Also, the

description makes no mention of a process on the second sternite. However, it is probable that Miss Sandhouse has seen the type and that this specimen is correctly determined. The process of the second sternite is small, somewhat compressed apically, when seen from beneath pointed at apex and much widened basally.

*Osmia* (*Acanthosmioides*) *wyomingensis*, new species

MALE.—Length nearly 8 mm. Blue, the front greenish, the vertex and dorsum of thorax blackish in many lights, the enclosure of propodeum purplish, the apical tergites greenish, the sides of first tergite brownish, the apical margins of tergites brown; flagellum crenulate, brownish red beneath; legs black, the fore and hind femora faintly bluish, the claw joints of tarsi reddish; mandibles black; tegulae black with a large brown spot occupying most of posterior part, the anterior ends blue. Wings quite clear, the basal vein meeting the transverse median, the second abscissa of cubital vein twice as long as fourth. Scutellum more coarsely punctate than scutum, without a median polished streak. Hind metatarsus broad at apex, tapering toward the base. Pubescence of head and thorax very dense, that of abdomen not so dense; pubescence of head and thorax whitish, the cheeks with a few dark hairs, the posterior part of pleura and sides and posterior face of propodeum with some black hairs, especially on propodeum; pubescence of clypeus of the usual erect dense type of this subgenus, but that of rest of face sparse, perhaps because of wear; pubescence white on dorsum of first two tergites, black at the sides of the second; third tergite with pale pubescence, mixed with black on posterior part of dorsum and replaced by black laterally; remaining tergites black-haired except for some pale hairs on dorsum of fourth; sternites with the pubescence largely black. Apex of abdomen as usual for the subgenus, the teeth of seventh tergite obtusely pointed; process of second sternite thick, closely appressed to the surface of abdomen, not very long, the base somewhat broadened (seen from beneath), the ventral edge convex, not grooved [superficially, when seen from the side, it looks like the process of the second sternite of *Alcidamea simplex* (Cresson), although in that species it is a tubercle on the disk of the sternite, while in the *Osmia* it is on the apical edge of the sternite, overhanging the third sternite].

Jackson, Wyoming, 6300 feet elevation, 43° 30' N., 110° 46' W., July 13–17, 1920 (Mrs. F. E. Lutz).

The process of the second sternite distinguishes this species at once from all previously described forms. I give a key to males of the subgenus *Acanthosmioides*. This is one of the most distinct groups of *Osmia*, but it easily falls within *Osmia*, as separated from *Chlorosmia* and other genera. Species marked by a (\*) are known to me only by the descriptions.

1.—Flagellum pale testaceous, except for a black tip to the flattened last joint.

(*O. watsoni* Cockerell has similar antennae but is not an *Acanthosmioides*.)

\**ashmeadii* (Titus).

Flagellum black above, dusky or brown below ..... 2.

- 2.—Posterior part of abdomen with pubescence largely black.....3.  
 Posterior part of abdomen with pubescence largely pale.....5.
- 3.—Process of second sternite thick and heavy, appressed to surface of abdomen, its ventral edge convex; posterior margins of tergites purplish brown.  
*wyomingensis* Michener.  
 Process of second sternite standing out from ventral surface of abdomen, the apex thin, laterally flattened, the ventral edge concave until the compressed apical part (which is rounded when seen in profile) is reached.....4.
- 4.—Robust greenish species; wings dusky.....*sladeni* Sandhouse.  
 More slender blue species; wings quite clear.....*nifoata* Cockerell.
- 5.—Process of second sternite with a small hook at tip.....6.  
 Process of second sternite not hooked at tip.....7.
- 6.—Length 10 mm.....*uncinata* Michener.  
 Length 15 mm.....*vanduzeei* Sandhouse.
- 7.—Pubescence of abdomen ochraceous at base and apex, short and fuscous on tergites two to four and base of five; process of second sternite probably similar to that of *O. nifoata*.....*\*odontogaster* Cockerell.  
 Pubescence of abdomen entirely pale; process\* of second sternite small, when seen from beneath wide at base and pointed at apex; length 10 mm.; differs from all other species known to me by the hind basitarsus, which tapers toward the apex, instead of toward the base.....*physariae* Cockerell.  
 Pubescence of abdomen very short and sparse, probably worn off, but apparently all pale; process of second sternite small, viewed from beneath wide at base and pointed at apex; differs from *physariae* by opaque blackish scutum and vertex.....*erecta* Michener.

#### CHLOROSMIA

The genus *Chlorosmia* was named by Sladen, to include certain brilliantly green, slender species. It has usually been considered as a subgenus of *Osmia*, but it seems to me to be at least as distinct as such forms as *Alcidamea* and *Monumetha*. *Chlorosmia* is characterized by its large stigma (for the group); deep sulcus, without a carina above it, on the first tergite; sixth and seventh tergites of the male unnotched, the sixth with lateral teeth, the seventh much exposed, somewhat excavated above; form very slender; notauli linear; scopa of female black; coloration bright blue or green. The following key separates *Chlorosmia* from its relatives:

- 1.—First tergite with a broad impunctate concavity, bounded by a strong carina.  
*Ashmeadiella*.  
 First tergite with a sulcus, and a fine, though distinct, carina separating the dorsum from the anterior face of the tergite; area in front of the carina nearly impunctate, in contrast to that behind it.....*Osmia*.  
 First tergite with a narrow sulcus, but no carina, the dorsal and anterior parts of the tergite not punctured in distinctly different ways.....2.
- 2.—Brilliantly metallic.....*Chlorosmia*.  
 Black.....*Hoplitina*, *Proteriades*, *Hoplitis*, *Alcidamea*, *Monumetha*, *Andronicus*.

I give a key to the species of *Chlorosmia*. I have seen all the species except female *C. viridimicans* (Cockerell).

#### MALES

- 1.—Large species. Antennae dilated, the scape very large, the flagellum broadened, especially near sixth segment (of flagellum), the ninth and following segments comparatively slender, the apical segment most slender, curved, and somewhat excavated beneath. Hair of abdomen largely black. Last visible tergite subtruncate, the truncation armed medianly with a stout spine; second sternite with a long slender median spine on the apical margin.

*viridimicans* (Cockerell).

Smaller species. Antennae normal. Pubescence all pale. Seventh tergite not so modified; second sternite with a small median tooth on apical margin. . 2.

- 2.—Seventh tergite broadly snout-like at apex, a portion of each lateral margin concave; apex of third sternite broadly truncated, the middle of truncation slightly convex, with a minute tooth. Tegulae green, a spot on posterior part shining black. . . . . *fulgida* (Cresson).

Seventh tergite broadly rounded, the margin convex throughout; third sternite without a median tooth on apical edge. . . . . 3.

- 3.—Third sternite broadly rounded behind. Tegulae entirely green. Second abscissa of cubital vein shorter than fourth; abdomen and hind legs strongly green, vertex and scutellum sometimes golden; length  $8\frac{1}{2}$  to 9 mm.

*lawae* Michener.

Third sternite truncated behind, slightly emarginate in the middle. Tegulae green, or black posteriorly. Second abscissa of cubital vein somewhat shorter than, or a little longer, than fourth; length  $8\frac{1}{2}$  to 10 mm.

*platyura* (Cockerell).

#### FEMALES

- 1.—First recurrent vein meeting or nearly meeting first transverse cubital. Pubescence black. Length 12 to 14 mm. . . . . *\*viridimicans* (Cockerell).

First recurrent vein far beyond first transverse cubital. Length 11 mm. or less. . 2.

- 2.—Tegulae practically all green. Pubescence all black, somewhat dilute and reddish on dorsum of head and thorax; scopa not in the least reddish. Venation as noted for male. . . . . *lawae* Michener.

Posterior third of tegulae black. Pubescence rather dark to pale fuscous; the scopa rather reddish. . . . . *platyura* (Cockerell).

Posterior two-thirds of tegulae black. Pubescence pale to dark fuscous, frequently reddish; apical part of scopa usually reddish. Size usually larger than in *lawae* or *platyura*. . . . . *fulgida* (Cresson).

The females of this group are difficult to identify, and, in view of the variability of male *C. platyura*, I suspect that some of the characters noted above for the separation of the females will break down.

#### *Chlorosmia lawae*, new species

Agrees with the description of *C. platyura* except as indicated above. The females are bluish but, as usual, variable. The male is the type.



Gull Lake, Mono County, California (type locality), July 11, 1934 (Mrs. J. E. Law); Altadena, California, April 18 and May 11, 1935, on *Phacelia tanacetifolia* (Michener); Aliso Canyon, Los Angeles County, California, May 3, 1931 (Michener).

***Chlorosmia platyura* (Cockerell)**

Pasadena, California, April 10, 1933 (Michener); Altadena, California, May 11, 1935, on *Phacelia tanacetifolia* (Michener). There seem to be all intergradations between the two extremes noted in the key to the males.

***Chlorosmia fulgida* (Cresson)**

Ward, Colorado, 9300 feet elevation, June 25, 1922 (F. E. Lutz, at dandelion); Boulder, Colorado, June 6 and 27, 1922 (F. B. Lutz, G. W. Strawbridge); Elbert, Colorado, 7400 feet elevation, June 9-11, 1922 (F. E. Lutz, at *Rubus deliciosus*); Leadville, Colorado, 10,000 to 11,000 feet elevation, July 7-14, 1896 (H. F. Wickham). The females vary from golden green [*C. viridis* (Cresson)] to blue. All males are green. Can the *fulgida* recorded by Sandhouse from California be *larvae* or *platyura*? Only females were recorded.

***Chlorosmia viridimicans* (Cockerell)**

Fallen Leaf Lake, Lake Tahoe, California (Van Dyke) (determined by Sandhouse).

In addition to the characters mentioned in the key, the following are noted for the male: pubescence of head and thorax entirely pale, of abdomen pale on first tergite, somewhat mixed on second, and black beyond; hair of sternites black.

This is an aberrant species, and might well form the type of a new subgenus or genus. The last segment of the male flagellum is somewhat like *Alcidamea*, while on the whole the flagellum reminds one of *Andronicus*. The antennae are much more strongly modified than in *Monumetha*.

***Chelynia pavonina* Cockerell**

Ward, Colorado, about 9300 feet elevation, June 25, 1922 (F. E. Lutz, at dandelion).





# AMERICAN MUSEUM NOVITATES

Number 876

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

July 31, 1936

## SOME WESTERN ANTHOPHORID AND NOMIINE BEES

BY CHARLES D. MICHENER

Types of the new forms described herein will be found in The American Museum of Natural History. I give a key to the forms of *Anthophora* falling under 6, Group E, Series I in Cockerell's table (1906).

- 1.—Hair of face all black..... *simillima californiensis* Michener.  
Hair of face mostly pale..... 2.
- 2.—Hair of hind basitarsi entirely black on outer side..... 3.  
Hair of hind basitarsi white, at least at base..... 4.
- 3.—Clypeus dull, finely rugose; smaller species..... *edwardsii* Cresson.  
Clypeus shiny, more coarsely rugose; large species.  
*chlorops utahensis* Michener.
- 4.—Hair of face below antennae entirely light..... 5.  
Hair of face below antennae with black intermixed, at least on lower sides of face near clypeus..... 7.
- 5.—Abdomen with only a very few black hairs intermixed among the pale; clypeus with a broad impunctate polished area in the middle. .... *forbesi* Cockerell.  
Abdomen with abundant short black hair on dorsum of fourth tergite and elsewhere; clypeus punctured throughout..... 6.
- 6.—Tegulae pale brown; second tergite with short dark hair on posterior half medially..... *lesquerellae* Cockerell.  
Tegulae black; second tergite with white hair except sometimes a few dark hairs on posterior margin..... *gohrmanae* Cockerell.
- 7.—Hair of dorsum of third tergite almost entirely pale, of following tergite pale with black intermixed; sides of face with but little black hair.  
*gohrmanae coloradensis* Michener.  
Dorsum of third tergite with some black hairs; hair of fourth tergite largely black..... 8.
- 8.—Outer side of fore and middle tibiae black-haired except for small pale spots at apices, or middle tibiae with some of hairs pale in certain lights; abdomen bluish; large species..... *pacifica* Cresson.  
Outer side of fore and middle tibiae largely pale-haired; abdomen black or hardly bluish..... 9.
- 9.—Hairs of outer side of middle and hind basitarsi white..... *subignava* Cockerell.  
Hairs of outer side of middle basitarsus black, of hind basitarsus black apically.  
10.
- 10.—Tegulae black or dark brown; clypeus with a somewhat irregular median longitudinal impunctate band..... *simillima* Cresson.  
Tegulae pale brown or testaceous; clypeus without such a band..... 11.
- 11.—Vertex with a broad band of black hair connecting the upper ends of the eyes and going just behind the ocelli..... *chlorops* Michener.

This band broadly broken by white (sometimes a few black hairs among the white).....*porterae* Cockerell.

*Anthophora forbesi* Cockerell probably falls in another group of Cockerell's key (1906), as it has rather distinct abdominal bands. *A. ignava* Cresson is the female of *A. pacifica* Cresson, as stated by C. Fowler long ago. The Michener species mentioned above but not described herein have been sent for publication elsewhere.

***Anthophora chlorops utahensis*, new subspecies**

FEMALE.—Similar to *A. pacifica* Cresson but hair of hind metatarsi black exteriorly; abdomen not bluish; pale hairs of sternites confined to extreme sides; tegulae margined with red on outer side; eyes (dried specimen) brown; head (in shape) and hind tibial spurs as in *A. chlorops* Michener.

Eureka, Utah, May 24, 1920 (Tom Spalding).

***Anthophora similima* Cresson**

Camp Roosevelt, Yellowstone Park, Wyoming, July 14–17, 1922 (Lutz).

***Anthophora neomexicana* Cockerell**

Plainview, Jefferson County, Colorado, July 9–14, 1922, elevation 7000–8000 feet (Engelhardt).

***Anthophora montana* Cresson**

White Rocks, near Boulder, Colorado, at *Cleome serrulata*, July 30, 1922, about 5500 feet elevation (Lutz); Eldorado Springs, Colorado, June 23, 1918 (L. O. Jackson).

***Anthophora occidentalis* Cresson**

Regnier, Colorado; Bryce Canyon, Utah, March 10, 1931 (I. Wilson).

***Anthophora edwardsii* Cresson**

Eureka, Utah, June 14, 1920 (Tom Spalding); Altadena, California, February 16, 1935, on *Buddleia* (Michener); Puddingstone Canyon, San Jose Hills, Los Angeles County, California, April 8, 1934 (Michener); Arvin, California, April 6, 1935, on *Amsinckia douglasiana* (Michener).

***Anthophora urbana* Cresson**

Claremont and mountains near Claremont, California (Metz); Fort Hall, near Blackfoot, Idaho, August 27, 1934 (Louise Ireland).

*Anthophora walshii* Cresson

White Rocks, near Boulder, Colorado, at *Cleome serrulata*, July 30, 1922, about 5500 feet elevation (Lutz).

*Emphoropsis mucida ventralis*, new variety

FEMALE.—Similar to *E. mucida* Cresson but scopa rather shining brown; hair of lower half of pleura, of venter of thorax, and many of hairs of cheeks blackish brown; hair of sternites black medially; hair on middle of apical margin of fifth tergite reddish.

Rawlins, Wyoming, June 26, 1920, about 41° 47' N., 107° 15' W., 6800 feet elevation (Lutz).

In some respects this resembles *E. murihirta* Cockerell but the latter species has many black hairs on scutum, etc.

A specimen of *E. mucida* from Cheyenne Pass, Wyoming, June 13, 1920, 41° 15' N., 105° 28' W., 8500 feet elevation, has dark hair on under side of thorax, thus approaching the form *ventralis*.

*Emphoropsis mucida* (Cresson)

Julesburg, Colorado, June 7, 1920, about 40° 59' N., 102° 15' W., 3460 feet elevation (Lutz). This specimen is unusual in having a white scopa and hairs of cheeks not mixed with black. A female from Cheyenne Pass (not the one recorded above under *E. mucida ventralis*, but with the same data as that individual) has several black hairs on dorsum of thorax, and the apex of the fourth tergite has some appressed white hair. In both of these characters it approaches *E. johnsoni* (Cockerell), which has a short white band at apex of fourth tergite. A specimen from Florissant, Colorado (previously recorded by Cockerell), has the scopa practically as yellow as in *johnsoni*.

A male from Apex Canyon, Boulder, Colorado, May 1, 1921 (L. O. Jackson), is apparently the male of *E. mucida*. The finding of a male for *mucida* (other than *E. morrisoni* (Cresson), which is probably distinct), makes it possible to consider *johnsoni* Cockerell a variety of *mucida* as was originally done. There seems to be too much variation and intergradation to consider them distinct species. *E. mucida* (male) differs from *E. mucida johnsoni* Cockerell (male) as follows: scape with a yellow line on basal half only; lateral face marks smaller, leaving a wider gap between them and yellow of clypeus; tergites three to five with considerable pale hair.

*Diadasia diminuta* (Cresson)

Denver, Colorado, June 18, 1918, on *Malvestrum coccineum* (L. O. Jackson).

***Diadasia australis* (Cresson)**

Aurora, Colorado, June 22, 1918 (L. O. Jackson); South Table Mountain, Golden, Colorado, June 20, 1918 (L. O. Jackson); Colorado Springs, Colorado, 6000–7000 feet elevation, June 15–30, 1896 (H. F. Wickham).

***Diadasia enavata* (Cresson)**

Salt Lake City, Utah, about 40° 45' N., 111° 45' W., 5000 feet elevation, July 28, 1920, in sunflowers in early rainy morning (Lutz).

***Melitoma grisella* (Cockerell and Porter)**

Regnier, Colorado.

***Nomia tetrazonata* Cockerell**

I refer a female from Florence Junction, Arizona, June 15, 1934 (M. and H. James), to this species. It is similar to the male but stigma darker; antennae black; legs mainly black. Evidently close to *N. foxii* Dalla Torre (which I have not seen), differing, to judge by notes under the description of *tetrazonata*, by the large punctures of third tergite, those of fourth being not very much smaller. This is as in *N. universitatis* Cockerell, which is larger, with more coarsely punctate pleura, vertex, etc. In *universitatis* the punctures of the basal part of the fourth tergite are smaller than those of the more sparsely punctate apical area of this tergite. In *N. tetrazonata* the punctures of the base of the fourth tergite are of the same size as, merely closer than, those of rest of tergite.

***Nomia californica* Cockerell**

Fort Hill, July 21, 1934, and Mill Creek, August 30, 1934, both near Blackfoot, Idaho (Louise Ireland).

# AMERICAN MUSEUM NOVITATES

Number 877

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

August 8, 1936

## NOTES ON THE ANATOMY OF THE VISCERA OF THE GIANT PANDA (*AILUROPODA MELANOLEUCA*)

By H. C. RAVEN

### INTRODUCTION

The material forming the subject of this report was preserved in the field by Mr. Donald Carter, naturalist of the Dean Sage West China Expedition.

Though previous expeditions had secured skins and skeletal material of the giant panda, this is, I believe, the first time anyone has preserved the viscera for anatomical investigation and we greatly appreciate the trouble that was taken to secure this important material. In view of the unique character of the material and its possible bearing upon the question of the relationships of *Ailuropoda* to *Ailurus*, the procyonids and the bears, it was deemed advisable to attempt a fairly full report upon the leading anatomical characters so far as preserved in our specimen.

The animal was shot by Mr. Sage on December 8, 1934, at an altitude of 7000 feet, at Cheng Wei, twenty-five miles west of Wenchwan, Szechuan, West China. It was an adult female and its measurements in the following table are compared with those of an adult female American black bear (*Euarctos americanus*) given by Seton (1929).

TABLE I

	<i>Ailuropoda</i>	<i>Euarctos</i>
Head and body	1460 mm.	1486 mm.
Tail	199	127
Height at shoulder	670	648
Height at rump	580	
Girth of thorax	1050	
Girth of belly	1280	
Length of hind foot	221	184
Weight		227 $\frac{1}{2}$ lbs.

These measurements show at a glance that this female giant panda was approximately the same size as the bear.

The material consisted of nearly the whole of the viscera. The im-



perfect preservation of liver and lungs, together with the lack of such important organs as the heart and larynx, necessarily restricts the scope of the present inquiry. Nevertheless the material has been deemed worthy of careful study and comparison.

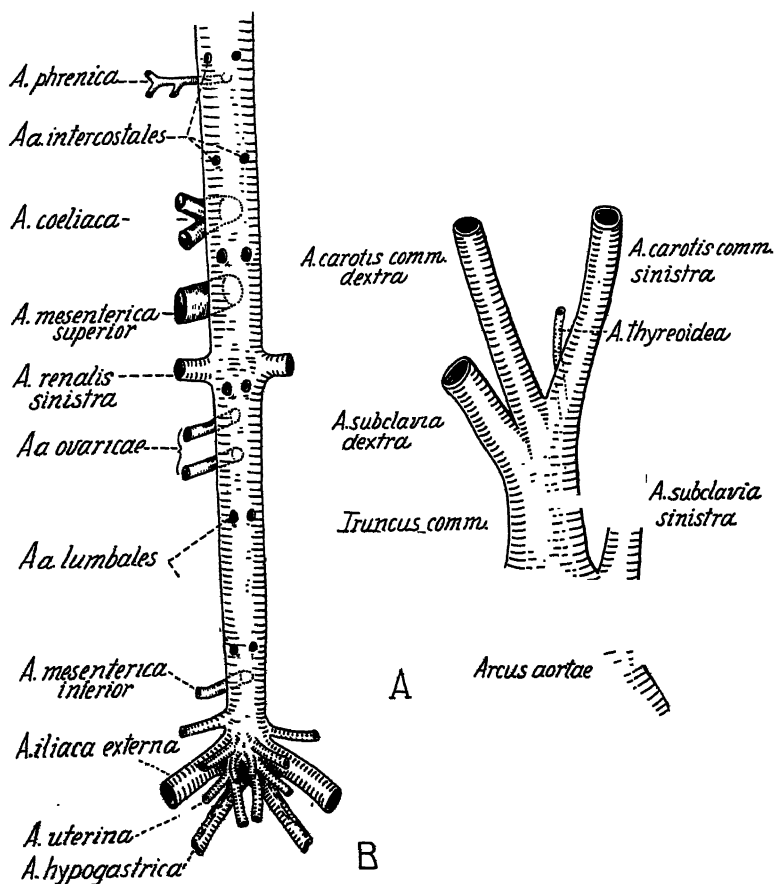


Fig. 1A. Aortic arch. B. Thoracic and abdominal aorta.

I am indebted to Dr. Herbert Fox of the Laboratory of Comparative Pathology of the Zoölogical Society of Philadelphia for the loan of part of the viscera of the small panda, *Ailurus fulgens*.

The other comparative material mentioned in the text is contained in the collections of the Department of Comparative Anatomy of The

American Museum of Natural History and was originally received from the New York Zoölogical Society, through the courtesy of that institution.

The drawings were made by Mrs. Helen Ziska.

#### BLOOD VESSELS

The shot that killed the animal tore away part of the upper left lobe of the lung and most of the base of the heart with its attached vessels.

Before preservation the material was divided: the anterior part of the tongue was one piece; the remaining internal organs were divided into two approximately equal parts and placed in two five-gallon oil tins with a weak solution of formaldehyde. The preservation was good, though the lungs, liver, etc., hardened very much out of shape.

The arch of the aorta (Fig. 1A) gives off two branches: the first and much the larger is the truncus communis, first giving rise to the right subclavian artery, then immediately dividing again to form the right and left common carotids. From the dorsal surface at the base of the left common carotid a small branch is given off which supplies the left lobe of the thyroid gland. Next beyond the truncus communis is the left subclavian artery. Thus in *Ailuropoda* the branches of the aortic arch conform to a pattern common to Carnivora. Parsons remarks (with reference to the arrangement of the branches of the aortic arch):

"... the terrestrial carnivora show little variation, and what there is depends on whether the left carotid rises from the cephalic part of the innominate, or whether the two carotids are fused into a common trunk for a short distance after the right subclavian is given off."



In *Ailuropoda* the carotids are fused for a short distance after the right subclavian is given off. The following table shows how this character is distributed among the Carnivora.

Caudad 15 mm. to the origin of the left subclavian artery on the dorsal side of the aorta, a single very small artery is given off and from there backward are pairs of segmental arteries (Fig. 1B) with the right one of the pair of those in the thoracic region slightly more caudad.

Rostrad of the diaphragm there are nine pairs of segmental arteries, and caudad to the diaphragm seven pairs, including the two pairs that form the terminus of the aorta. The phrenic artery is single; it comes from the ventral surface of the caudal part of the thoracic aorta.

The renal arteries are directly opposite each other. The ovarian arteries take origin, one behind the other, from the mid-ventral line of the abdominal aorta.

TABLE II.—Arrangement of Branches of Aortic Arch in Carnivora.  
(Partly after Parsons, 1902.)

			
		TYPE A	TYPE B
Felidae	<i>Felis leo</i>	4/4	
	" <i>pardalis</i>	1/2	1/2
	" <i>catus</i>		3/3
	" <i>tigris</i>		2/2
	" <i>pardus</i>		1/1
	" <i>concolor</i>		1/1
	" <i>tigrina</i>		1/1
Viverridae	<i>Herpestes</i>	1/1	
	<i>Cryptoprocta</i>	1/1	
	<i>Nandinia</i>	1/1	
	<i>Genetta</i>	1/2	
	<i>Arctictis</i>	1/1	
Hyaenidae	<i>Hyaena</i>	1/1	
Canidae	<i>Lycan</i>	2/2	
	<i>Canis familiaris</i>	4/4	
	" <i>lupus</i>	1/1	
	" <i>vulpes</i>	3/3	
Procyonidae	<i>Procyon</i>	2/3	1/3
	<i>Cercoleptes</i>		1/1
	<i>Nasua</i>	1/3	2/3
	<i>Ailurus fulgens</i>		1/1
	<i>Ailuropoda melanoleuca</i>		1/1
Ursidae	<i>Euarctos americanus</i>		2/2
	<i>Helarctos</i>		1/1
Mustelidae	<i>Galictis vittata</i>	1/1	
	" <i>barbara</i>	1/1	
	<i>Idonyx</i>	1/1	
	<i>Mustela erminia</i>	2/2	
	" <i>putorius</i>	2/2	
	<i>Lutra</i>	1/1	
	<i>Gulo</i>		1/1

The inferior mesenteric artery is very small and has its origin about 3 cm. from the termination of the aorta.

The terminal branches of the aorta are unlike those of anything I have seen except in *Ailurus*. The external iliac arteries are the largest branches, the left one slightly higher than the right. Caudad to the external iliac arteries are the hypogastric arteries, intimately connected with and paralleled by a fibrous cord of connective tissue. Between the external iliac and the hypogastric arteries and more dorsal is a pair of arteries sending branches to the uterus. As the remaining small arteries, four pairs, had been cut off short, their distribution could not be ascertained.

The vena cava inferior is double up to the level of the middle of the

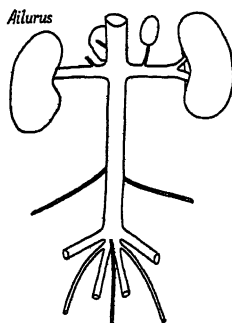


Fig. 2. Abdominal aorta of *Ailurus*.

kidneys (Fig. 12A and B). This condition is reported by Beddard (1909, p. 493) for a number of carnivores. He writes as follows: "Thus it is the Arctoid Carnivora, and possibly chiefly the Musteline division of that group, in which the double postrenal postcaval vein is to be met with." In *Ailurus* I found the condition of the postrenal-postcaval vein to be approximately the same as in *Ailuropoda*.

The renal veins of *Ailuropoda* are decidedly asymmetrical in their entrance into the vena cava inferior; that of the left side is more caudad, thus agreeing with *Ailurus*, *Cercoleptes*, *Euarctos* and *Vulpes*. In *Nasua* and *Procyon* the left renal vein enters the vena cava posterior in advance, rostrad of that of the right side and in *Helarctos* they are opposite each other. Beddard (p. 493) states that: "The Arctoid genera, in their wide distribution, nearly plantigrade feet, only at most slightly specialized carnassial teeth, and with their nonretractile claws, lie at a lower level than the Aeluroidea. This result may be perhaps taken into consideration along with the postrenal section of the postcaval. In the

same direction also points the more usual symmetry in the position of the renal veins; these very frequently, more frequently than in the Aeluroidea, open into the postcaval opposite to each other. Again, it is more common in this subdivision of the Carnivora for asymmetry to be shown in the position of the spermatic or ovarian veins."

In *Ailuropoda* the ovarian veins, though slightly asymmetrical, join the vena cava posterior just caudad to the renal veins. This is the case in *Ailurus*, though in the latter they are a little more caudad. In the procyonids, ursids and canids mentioned above the right ovarian (or spermatic) vein joins the vena cava inferior directly, whereas the left one joins the left renal vein.

#### TRACHEA AND LUNGS, THYROID GLAND

The trachea (Fig. 3) had been cut through near the upper pole of the thyroid gland, so the exact number of tracheal rings could not be determined, but in the part that remained are twenty-four rings and the total number probably did not exceed twenty-seven. In *Ailurus* there are thirty-eight cartilaginous tracheal rings, according to Flower (1870, p. 759). The trachea in *Ailuropoda* is 36 mm. in greatest diameter and the membranous part behind is 6 mm. wide. The two bronchii into which the trachea divides are short and each subdivides again into upper and lower branches. The left bronchus is a little longer and not quite as large as the right.

The left lung consists of two lobes completely separated by a fissure. The lower lobe is somewhat larger and more irregular in form than the upper.

The right lung consists of four distinct lobes. The right upper lobe, supplied by the eparterial bronchus, is about equal in size to the lower lobe of the right side. Lying between the right upper and lower lobes is the right median lobe, which is about half the size of the adjacent lobes. It is supplied by the superior ventral branch of the hyparterial bronchus. The right lower lobe is similar to the left lower lobe but slightly smaller. The ligamentous connections of the lower lobes of both sides not only surround the root but extend along their dorso-caudal margins to the diaphragm. The azygos lobe is not more than half the size of the median lobe and lies medial to the lower part of the right lower lobe. It is deeply fissured, the fissure extending nearly halfway from its apex to the root.

All the lobes are separate, that is, not connected by lung tissue at

their roots. In this character *Ailuropoda* differs from *Ailurus*. In general, however, they conform to the usual carnivore pattern.

The right thyroid body was not preserved. The left half of the gland (Fig. 3), however, is nearly complete and measures 55 mm. in greatest length by 25 mm. in width. It is irregularly lobulated, nearly straight

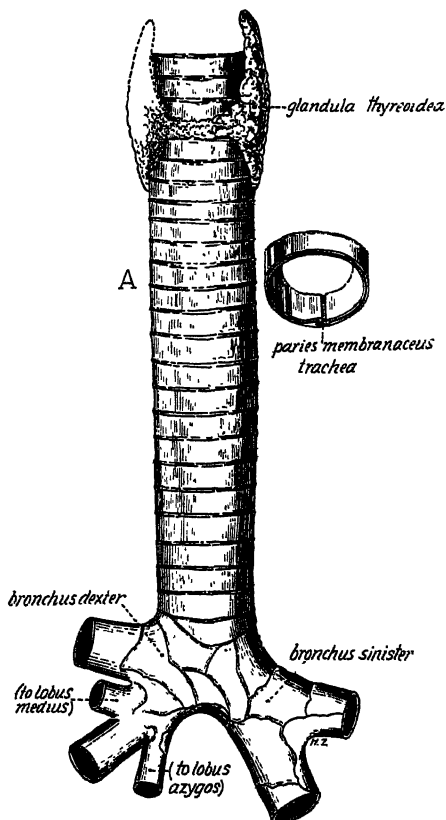


Fig. 3. Trachea and thyroid gland.

on its medial border. The dorso-lateral border is convex. The isthmus curves downward to the median line and measures 25 mm. in length from the right to the left parts of the gland, by 10 mm. in width.

#### ALIMENTARY TRACT

The preserved oral part of the tongue (Fig. 4) measures 14 cm. in length, 13 cm. from the most rostrad of the vallate papillae to the apex

of the tongue. Its greatest width is just behind the middle, where it measures 5 cm. The tip is free for 7 cm.

The tongue is covered with four kinds of papillae. The most abundant and the most variable are the conical papillae, which are large near the apex, above and below, also along the lateral borders and in the region of the vallate papillae. They are very small and close set over most of the dorsum of the tongue and lacking on the sides and under sur-

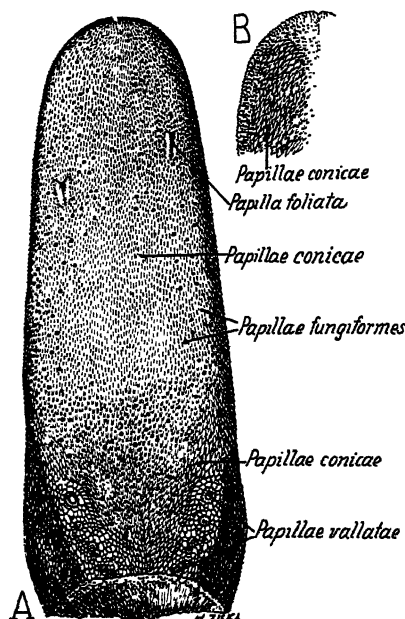


Fig. 4. Tongue.

face, except near the apex and adjacent lateral borders. Since the base of the tongue is cut off, comparisons with other arctoids are not possible.

The foliate papillae are two in number, one on each side of the dorsum of the tongue. Carlsson (p. 292) records these structures in *Ailurus*. According to Sonntag (p. 145), they occurred in *Procyon lotor*, *Ursus maritimus* and *Melursus ursinus*, but he found no trace of them in *Ailurus*, *Procyon cancrivorus*, *Nasua narica*, *Cercoleptes caudivolvulus* or many mustelids.

The fungiform papillae are rather numerous, plainly visible and well separated on the dorsum of the tongue except in its middle area, where they are entirely absent. According to Sonntag (pp. 144, 145) the fungi-

form papillae of arcoid carnivores range from "just visible to the naked eye" in the Mustelidae and some species of *Ursus* to "small but obvious" in some mustelids, *Procyon* and *Ailurus*, to relatively large and prominent in *Nasua*. Thus in size the fungiform papillae in *Ailuropoda* approach those of *Nasua* and differ from those of *Ursus*. They contrast with those of *Ailurus* (Carlsson, p. 292) in not being covered by the papillae filiformes (= conical) and in their absence from the central tract of the dorsum of the tongue, also in being less crowded together both at the base and at the apex.

The vallate papillae preserved are six pairs but had the whole tongue been preserved there might have been seven or eight pairs, or fifteen or seventeen arranged in a V-formation, the caudal part of which is now lacking. Some of the papillae vallatae are subdivided into one larger and one smaller, so that the variable number in Procyonidae as a whole (see below) is not surprising. Carlsson (1925, p. 292) and Sonntag (1923, p. 144) record the number of vallate papillae in the Procyonidae as ranging from 6 in *Bassaricyon*, 6-10 in *Cercoleptes*, 8 in *Nasua*, 12-14 in *Procyon*. The possibly high number (estimated maximum 17) in *Ailuropoda* exceeds that of *Ailurus* (11) and comes within the range in the Ursidae (16-20).

There is a very slight median fissure at the apex and extending back for a centimeter on the under side of the tongue.

The oesophagus (Fig. 7B) is flattened dorsoventrally and has a rather thick muscular coat. It is lined with a smooth, almost horny epithelium with no conspicuous glands. The inner surface is thrown into longitudinal folds that terminate abruptly at the stomach.

The stomach (Figs. 5, 6, 7) is long and slender. The fundus does not bulge excessively and from it there is a gradual tapering toward the pyloric portion, which is sharply bent upward, as described by Flower (p. 761) and by Carlsson (p. 293) for *Ailurus*, but does not agree with Flower's figure in its proportions. Along the greater curvature from the cardia to the pylorus it measures 80 cm. and in its moderately distended, food-filled condition has a greatest diameter of 13 cm. Its diameter at the pyloric sphincter is 5.5 cm. The longitudinal muscle fibers of the stomach can be seen through their peritoneal covering.

The ligamentum hepato-gastricum and a strong ligamentum hepato-duodenale, which by part of its insertion marks the position of the pyloric sphincter (Fig. 6), hold the pylorus close to the cardia and pressed against the lesser curvature of the stomach. In fact it would seem the pylorus could never move more than 10 cm. from the terminus of the



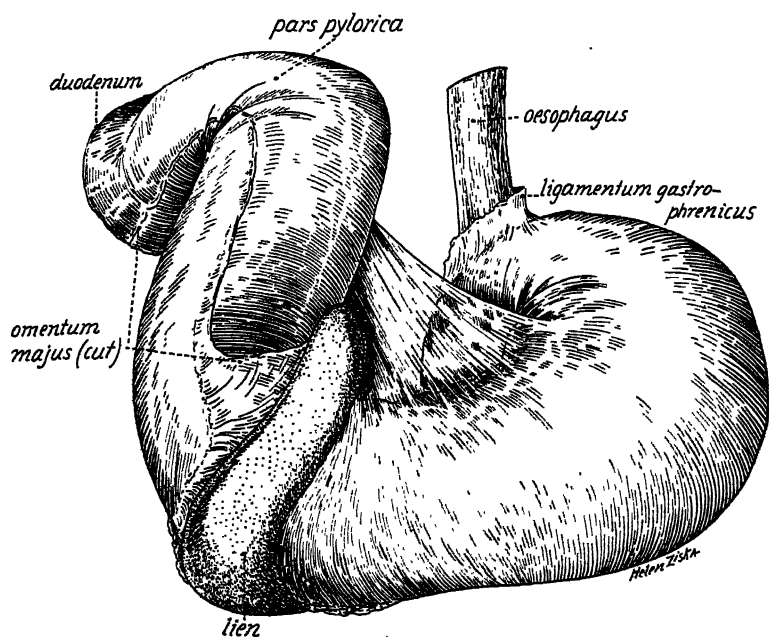


Fig. 5. Ventral or caudal view of stomach.

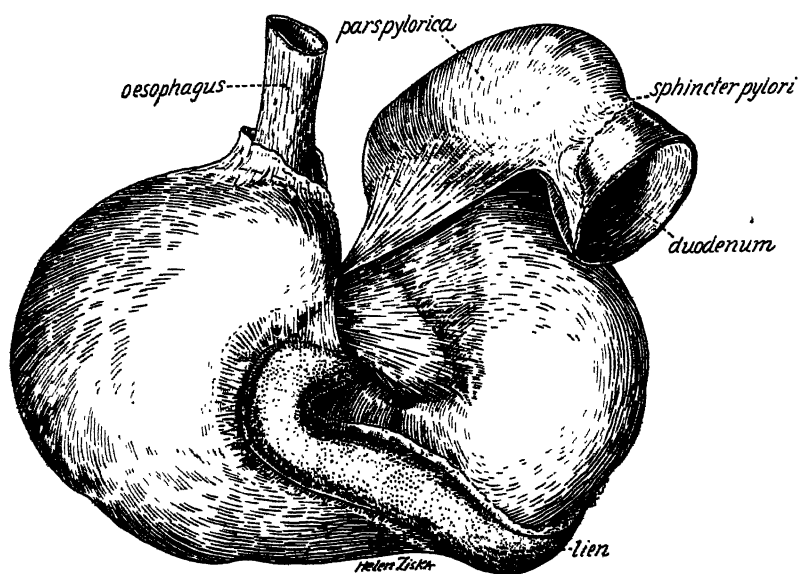


Fig. 6. Diaphragmatic or dorsal view of stomach.

oesophagus. The walls of the stomach are much stronger and thicker than those of the duodenum. The muscular coat of the pyloric region is 2 mm. in thickness, at the pyloric sphincter, 6 mm., and that of the duodenum 4 cm. from the pylorus is about 1 mm. thick. The mucosa of the stomach (Fig. 7) in the region of the fundus was thrown into a series of folds, doubtless through the contraction of the muscular walls of that region.

The mucous membrane appears alike over the whole of the organ.

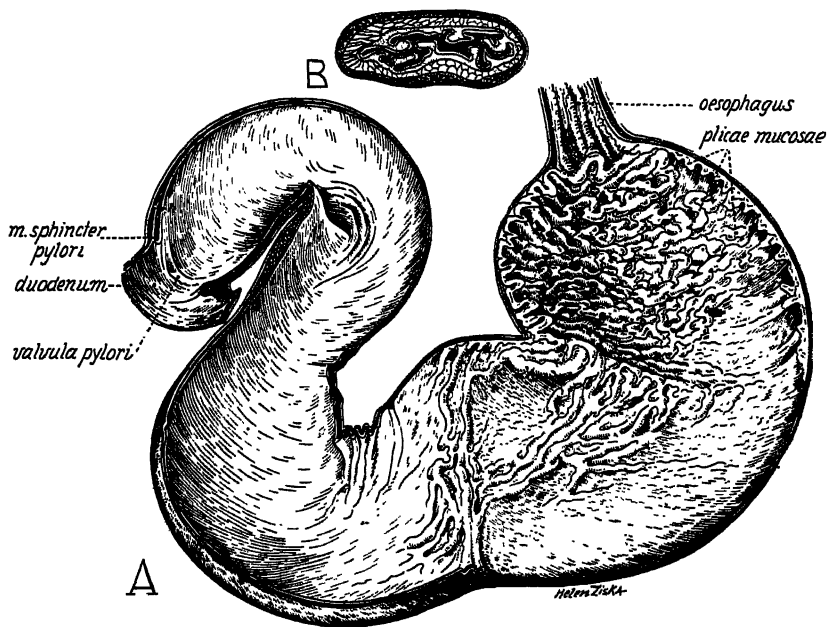


Fig. 7A. Section of stomach from oesophagus to duodenum.

B. Cross-section of oesophagus. About 1/1.

The difference between the horny lining of the oesophagus and the soft membrane lining the stomach is not alone in texture but in color; that of the oesophagus in the preserved specimen being whitish, whereas that of the stomach is dark grayish green. On the whole, the stomach of *Ailuropoda* is much like that of *Ailurus* but has relatively thicker walls.

The liver has six distinct lobes (Fig. 8). A left lateral lobe, which is simple, flattened and triangular in outline, has a thin free margin without notches. On its inferior surface opposite its free border, close to the transverse fissure, there is a small tongue-shaped accessory lobule such as

is recorded for *Ailurus* by Flower (1870, p. 762), who also says: "This lobule is slightly indicated in *Nasua*."

The left lateral lobe is overlaid in part by the left central lobe and its medial border is close to the left border of the right central or cystic lobe. The left lateral lobe is connected with the left central lobe by a triangular ligamentous band.

The left central lobe is about the same size as the former and not so flattened. It is nearly triangular, with an almost straight lateral border which is applied to the diaphragmatic surface of the left lateral lobe. From its wedge-shaped free apex its medial border is curved to its root, with but one small notch which is near its apex. It is separated from the right central lobe by the falciform ligament.

The right central lobe is larger than either of the left lobes. Viewed from behind, its general outline is oval. Its apex, which is near the ligamentum falciformis, is provided with four shallow notches. From the deepest of these there is a small ligament connected with the fundus of the gall-bladder. The gall-bladder occupies a depression at the basal half of the left side of this right central lobe, its fundus reaching but little more than half-way to the apex of the lobe. To the right of the gall-bladder and paralleling it, is a well defined fissure, the extremities of which do not reach the borders of the lobe. A wide isthmus connects the right central with the right lateral lobe. The pars quadrata is not distinct, agreeing with *Ailurus*, *Procyon* and *Nasua* and in contrast with *Ursus*, in which it is prominent (Carlsson, p. 295).

The right lateral lobe is nearly round in outline and larger than any of the other lobes. Its margin is devoid of notches. Intimately connected with the right lateral lobe are the two remaining lobes, the caudate lobe and the Spigelian lobe.

The caudate lobe is very small, irregular in shape, with sharp angles, and is grooved for the passage of the vena cava inferior. In *Ailurus*, according to Flower (p. 764) and Carlsson (p. 295), the caudate lobe is very large, but in my specimen the caudate lobe is small and similar to that of *Ailuropoda*. On three sides its margin is separated from the right lateral lobe by a fissure.

The Spigelian lobe is long, slender and trihedral, especially the free end. For more than half its length it is intimately connected with the right lateral lobe but also in part with the central lobe.

The gall-bladder (Fig. 8) is 6 cm. long and its duct joins the hepatic duct 5.5 cm. from the neck of the gall-bladder.

The ductus choledochus (Figs. 8 and 9) and the ductus pancreaticus

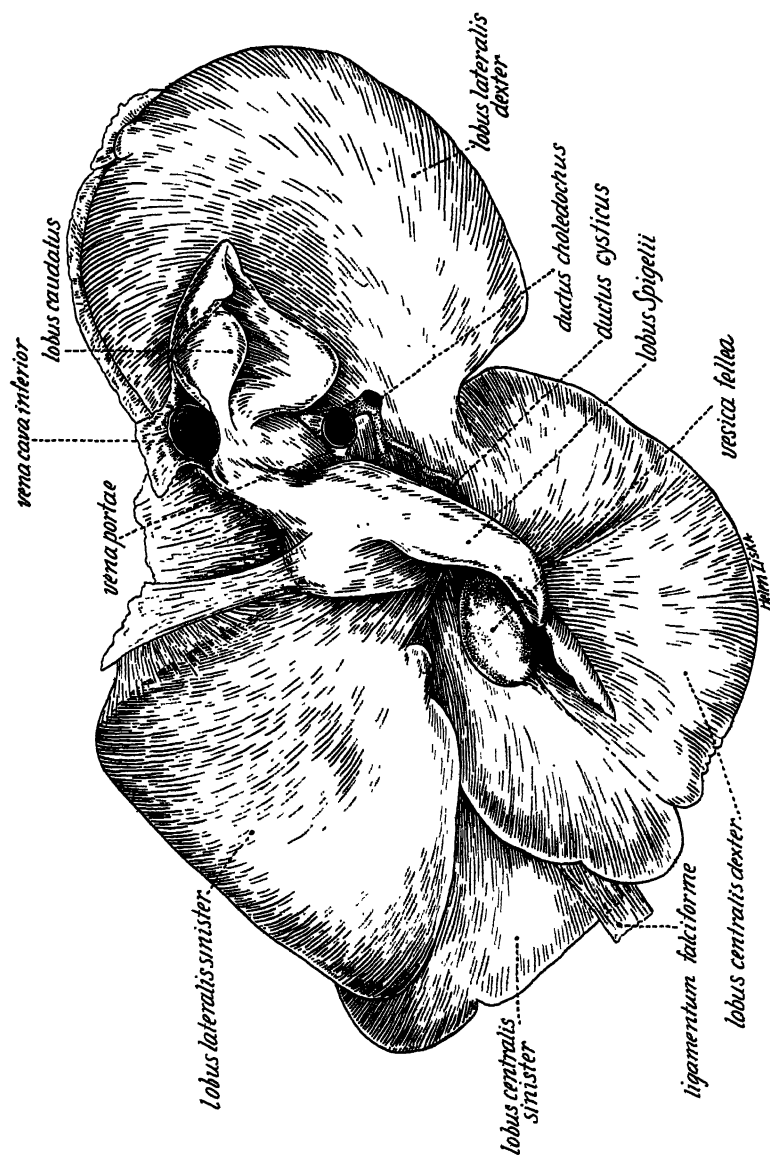
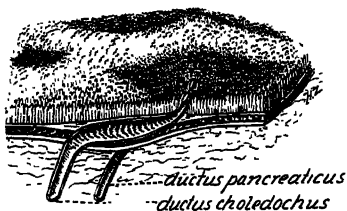


Fig. 8. The liver, ventral or abdominal view.

(Fig. 9) open into the duodenum separately, the distance between the two openings being 3 or 4 mm.

The lining of the ductus choledochus is smooth to 15 mm. from its termination. When it enters the duodenal wall it broadens somewhat

Fig. 9. A diagram of the ampulla of the bile duct and a section of the duodenum.



to form the ampulla and its inner surface is lined with lamelliform rings. The character of the lining of the ductus pancreaticus also changes when it enters the duodenal wall but its lining, though resembling that of the ductus choledochus, has much finer rings and does not increase in diameter.

The pancreas (Figs. 10A and B) is large for a carnivore, probably as-

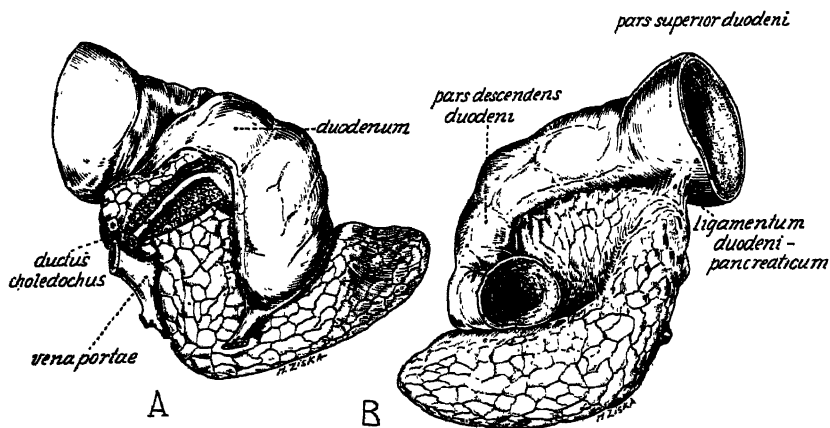


Fig. 10. Pancreas and duodenum. A. Ventral view. B. Dorsal view.

sociated with its specialized herbivorous diet, and very irregular in shape, but on the whole much more compact than in various procyonids, ursids and canids used for comparison.

The intestine is thick-walled, of fairly uniform diameter and not very long. It measures eight meters from the pyloric sphincter to the

anus in its preserved condition, without stretching, and would of course have measured more when it was fresh. Of this, 110 cm. belongs to the colon and rectum.

At the moment of death the proximal part of the duodenum was dis-

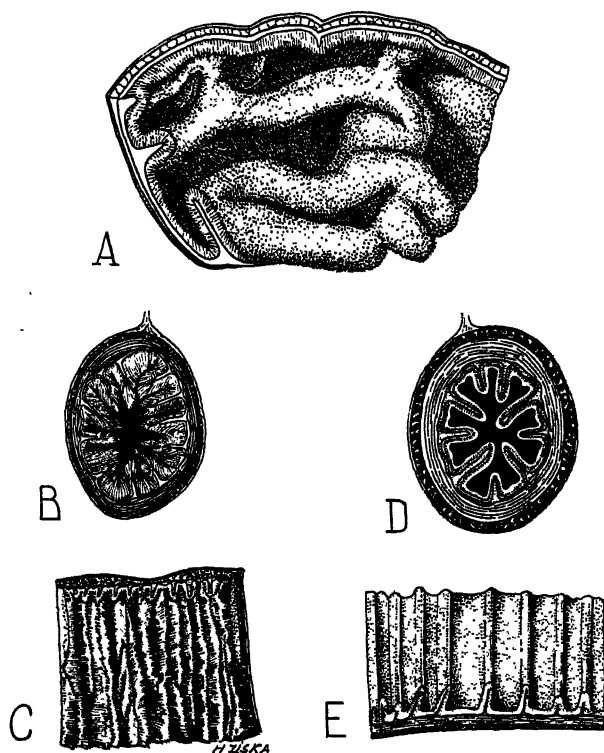


Fig. 11. Details of intestine.

- A. Section of the duodenum showing character of the folds of the mucosa.
- B. The small intestine; cross-section showing heavy muscular walls and villi.
- C. Section opened out showing longitudinal folds covered with villi.
- D. Transverse section of the colon.
- E. The mucosa arranged in longitudinal folds.

tended with food, consequently its diameter is large and its mucosa devoid of folds. Beyond this it is constricted and the mucosa thrown into numerous folds (Fig. 11A), most of which are longitudinal but branch to form connections with other folds. The duodenum is lined with close-set villi, each about 2 mm. long, giving to the whole an appearance of

ivory-colored plush. The bile and pancreatic ducts empty into the duodenum 10 cm. from the pylorus. There is a duodenal fold or ligament from the lower or caudal part of the duodenum to the caudal part of the mesocolon.

The jejuno-ileum is lined with villi, differing very little in appearance from those of the duodenum. There are no Peyer's patches. Carlsson reports (p. 294) that Peyer's patches are few in *Ailurus*. In my specimen of *Ailurus* there was but one small one. In *Euarctos americanus* Peyer's patches were abundant and large. They were present also in *Cercoleptes*, *Procyon*, *Nasua*.

There is no caecum (as in *Ailurus*, *Nasua*, *Cercoleptes*, *Procyon*, *Ursus*), nor is there any external indication of the exact site of the ileo-colic junction. However, its approximate location may be determined, for beneath the peritoneal covering of the colon, on its sides as well as along the mesentery, are to be seen accumulations of fat which do not occur about the sides of the ileum. These accumulations of fat do not form epiploic appendages in this specimen.

The ileo-colic junction is well marked internally by the change in the

TABLE III

Relative lengths of the alimentary tract and its divisions in Carnivora	Length of: Colon and rectum		Jejuno-ileum		Duodenum		Stomach (grt. curv.)		Oesophagus and tongue		Alimentary tract (total)		Head and body		Proportion of head & body to alimentary tract		Proportion of alimentary tract to head and body	
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	%	%	%	%	
<i>Nasua</i>	14	180	12	10	24	240	46	19.1	521									
<i>Procyon</i>	20	256	14	14	28	332	49	14.7	677									
<i>Cercoleptes</i>	15	126	8	12	25	188	43	22.8	437									
<i>Ailurus</i>	15	195	13	15	37	275	61 <sup>1</sup>	22.1	450									
<i>Ailuropoda</i>	110	663	27	80	59	939	146	15.6	643									
<i>Euarctos</i>	16	579	17	35	80	727	90	12.3	807									
<i>Vulpes</i>	24	86	17	16	36	179	62	34.6	288									
<i>Helarctos</i> <sup>2</sup>	23	275	12	30	32	372	59	15.8	630									
<i>Felis yagouaroundi</i>	21	105	12	15	26	179	46	25.6	389									
<i>Felis pardalis</i>	23	170	16	24	39	272	69	25.3	394									
<i>Paradoxurus</i>	21	177	9	17	28	252	47	18.6	536									

<sup>1</sup> Head and body measurement taken from another individual of the same sex.

<sup>2</sup> Very young animal.

mucosa. That of the ileum (Fig. 11B and C) is lined with short villi, whereas that of the colon (Fig. 11D and E) presents a smooth surface arranged in a series of longitudinal plicae.

The proportions of different parts of the alimentary tract in various carnivores, as measured by me, are as shown in Table III.

This table shows, as might be expected, that the digestive tract is relatively longer in those forms in which vegetable matter forms a large part of the food.

#### SUPRARENAL GLANDS

The right suprarenal gland is situated near the upper medial pole of the kidney. This gland and the kidney are both slightly higher, more rostrad, than those of the left side. Its dorsal surface rests against the diaphragm, its ventral surface against the postcaval vein and its lateral border partly against the caudate and partly against the right lateral lobe of the liver. It measures 31 mm. in length by 23 mm. in width and 12 mm. in greatest thickness. Its main arteries are two which enter from the dorsal surface; one comes directly from the ventral border of the aorta, whereas the other arises from the right renal artery. The right suprarenal vein is very short, going directly into the side of the postcava.

The left suprarenal body rests dorsally against the diaphragm; ventrally it faces the stomach, medially the postcaval vein and laterally the rostro-medial border of the kidney. It is much larger than the suprarenal gland of the right side and measures 48 mm. in length by 27 mm. in greatest width, by 11 mm. in thickness. The main artery arises from the lower left renal artery. Its vein grooves the ventral surface of the gland and joins the postcava just above (rostrad to) the renal vein.

#### UROGENITAL SYSTEM

The right kidney (Fig. 12A and B) is placed slightly more craniad than that of the opposite side. Both are surrounded by a quantity of fat and are distinctly lobulated, each having six lobuli. The right kidney measures 112 mm. long by 62 mm. wide and 26 mm. thick; the left 108 mm. long, 55 mm. wide and 25 mm. thick. The kidneys differ from those of *Procyonidae* and *Ailurus* in being lobulated, as in most larger mammals, including the bears.

The ureter is somewhat flattened where it emerges from the kidney but for nearly the whole of its length it is nearly circular in section. It runs in the wall of the bladder for 10 mm. For a corresponding distance on the inside of the bladder there is a raised rounded ridge on which the



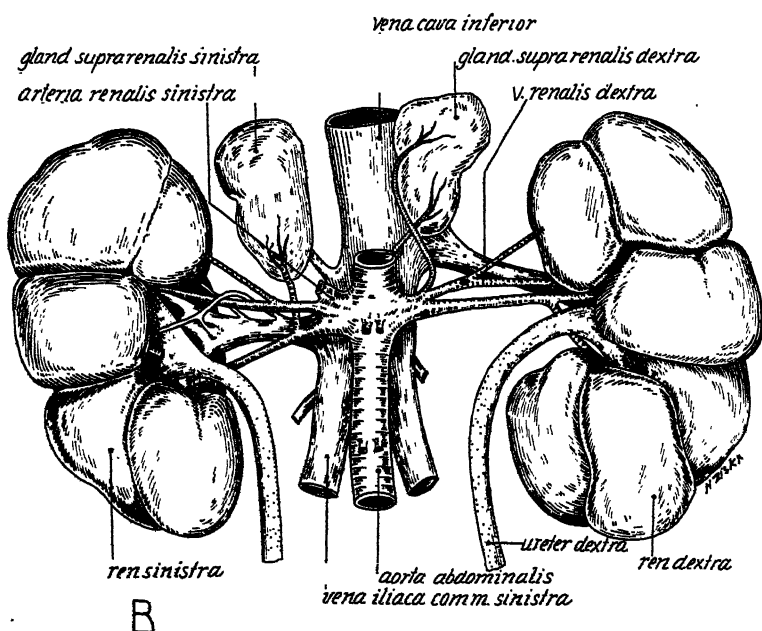
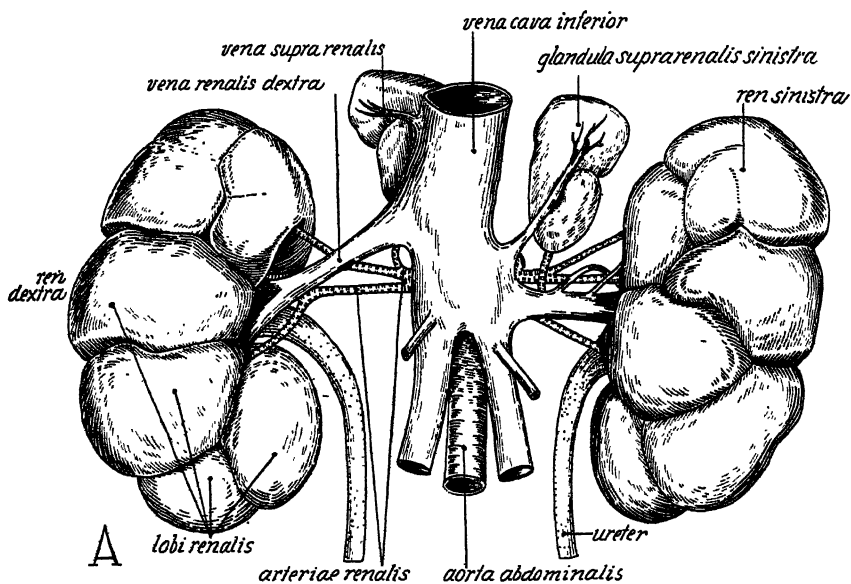


Fig. 12. Kidneys, suprarenals and their vessels. A. Ventral view. B. Dorsal view.

ureteral orifice is located. The lateral margins of the ridge of each side continue in diminished form as they converge at the opening of the urethra.

The bladder (Figs. 13 and 14C) is rather pointed and widest about the middle, with very heavy muscular walls. Its length contracted is 110 mm. From the ureteral orifice to the beginning of the urethra is 45 mm. The distance between the openings of the two ureters is 20 mm.

Behind the ureteral prominences the mucosa of the bladder is thrown

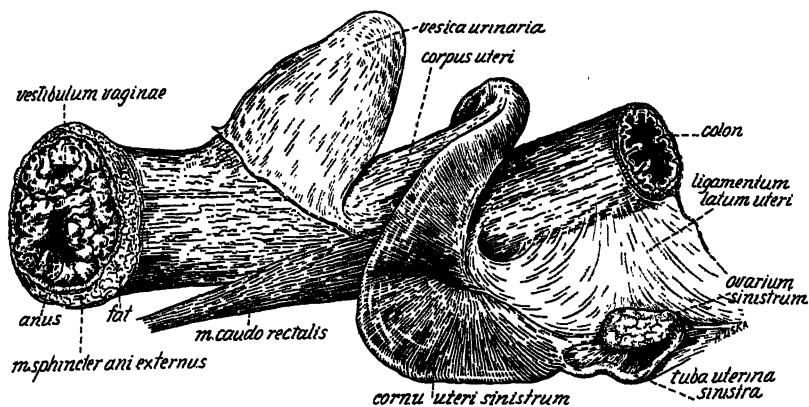


Fig. 13. Ovary, uterus, bladder and rectum, from the left side.

into a series of folds in its contracted state but that of the trigonum remains smooth.

The urethra is irregular in section, due to its longitudinal folds. The diameter of its lumen is about 3 mm. and its length is 40 mm. It opens into the urogenital sinus from a rounded tubercle 15 mm. in diameter.

The ovary is slightly flattened, rounded, and its surface is fissured and pitted, thus having somewhat the appearance on the surface of a highly convoluted brain. It measures 30 mm. in length by 23 mm. in width and 11 mm. in thickness.

The uterine tube is very much contorted but when straightened measures 95 mm.

The corpus uterus is less than half the length of the cornua and slightly depressed. The cornua are rounded on the free edge and diminish in thickness toward the broad ligament. The surface of the uterine mucosa is arranged in a mosaic with distinct clefts separating the smooth areas making up its surface. The mucosa has the same

appearance over its entire surface from the extremities of the cornua to the cervix. The cervix is strong with comparatively thick muscular walls.

The vagina, which has a total length of 85 mm., is narrow with firm muscular walls. Its mucosa forms a series of closely-set, transverse circular folds. Caudally the vagina is bounded ventrally by the tu-

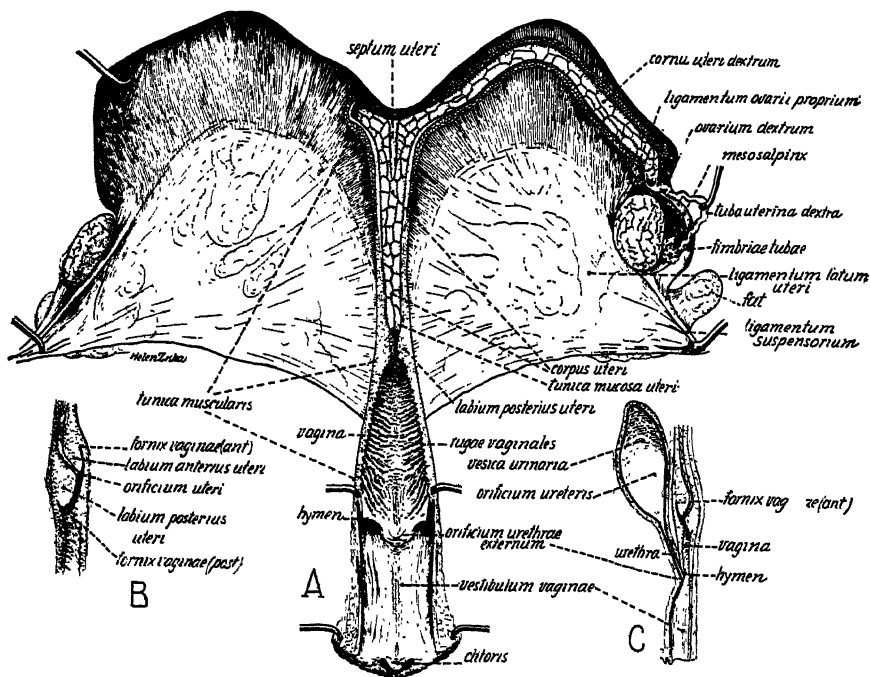


Fig. 14. Female genital apparatus.

A. From the dorsal side; vestibule and vagina opened along mid-dorsal line and spread out.

B. Median sagittal section through region of cervix, viewed from the right.

C. Median sagittal section of posterior part of urogenital apparatus, viewed from the left.

bercle, on the center of which is the urethral opening, laterally and dorsally by the hymen, which is a fold 8 mm. long.

The urogenital sinus, like the vagina and corpus uterus, is flattened so that, though not wide, it is more extensive transversely than dorso-ventrally.

Of the specimen under consideration there is preserved only a very

little of the skin surrounding the genital and anal openings. It is bare except for a few hairs. On this skin are the openings of numerous glands, which when squeezed express an oily substance.

Lateral to the dorsal limit of the genital opening on each side is a rather large crypt, which contains the minute openings of many of these glands.

#### SUMMARY AND CONCLUSIONS

The parts of our specimen of *Ailuropoda melanoleuca* that are sufficiently well preserved to merit description include some of the larger

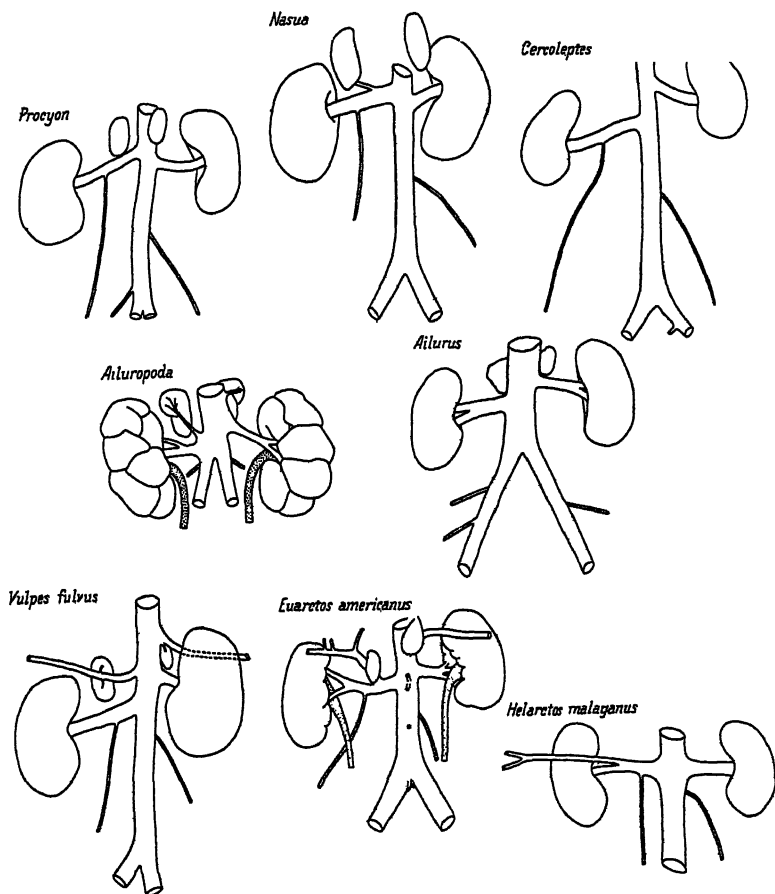


Fig. 15. Comparative views (dorsal) of vena cava inferior, renal and ovarian veins in procyonids, a canid, and two ursids.

blood vessels, the trachea, lungs, alimentary tract and female urogenital system.

The main anatomical characters of the viscera and circulatory system of *Ailuropoda* may be summarized under two main aspects: A. Habitus characters; B. Characters of taxonomic or phylogenetic significance.

A.—Habitus characters of the viscera associated with specialized herbivorous diet:

- (a) The extremely horny lining of the esophagus;
- (b) The thick-walled, muscular and elongated stomach;
- (c) The proportionately small size of the liver (in flesh-eaters it is relatively larger);
- (d) The comparatively small size of the gall-bladder, presumably associated with more continuous feeding;
- (e) The large size of the pancreas;
- (f) The elongation of the jejuno-ileum.

B.—Characters of taxonomic or phylogenetic significance:

1. Visceral characters:
  - (a) Shape of the stomach most closely resembling that of *Ailurus*;
  - (b) Lobes of the liver similar to those of *Ailurus*;
  - (c) Ileo-colic junction practically identical with that of *Ailurus*;
2. Vascular characters:
  - (a) Vena cava inferior double to the level of the kidneys, similar to that in *Ailurus*; (Fig. 15);
  - (b) Ovarian veins entering the vena cava inferior directly (neither of them enters a renal vein, a character shared with *Ailurus*);
  - (c) Terminal branches of the abdominal aorta similar to those of *Ailurus* (Fig. 2) and differing from the remaining procyonids and at least two genera of ursids.

Although the phylogenetic significance of the characters of the soft anatomy seem to be in general inferior to those of the skull and teeth, yet they do tend to show that the nearest living relative of *Ailuropoda* is *Ailurus* and that its resemblances to the bears are an expression of convergence in size and food habits.

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# AMERICAN MUSEUM NOVITATES

Number 878

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

August 8, 1936

## ON THE PHYLOGENETIC RELATIONSHIPS OF THE GIANT PANDA (*AILUROPODA*) TO OTHER ARCTOID CARNIVORA

By WILLIAM K. GREGORY

### INTRODUCTION

In 1875 Milne-Edwards in a memoir on *Ailuropoda melanoleuca* published the conclusion that this curious beast must occupy a position intermediate between the bears and the panda (*Ailurus fulgens*). In 1891 Flower and Lydekker in their work on 'Mammals, Living and Extinct' placed "*Aeluropus*" in the Ursidae, and it is indeed so bear-like in general appearance that it has often been called "the parti-colored bear." In 1895 Winge (as interpreted by Bardenfleth, 1914), "places still more exclusively *Aeluropus* among the Ursidae as a very near relative of the *Hyaenarctus*, these two forming together a branch of the Ursine stem, whereas *Ailurus* belongs to the Procyonine stem of Procyonidae whose root is *Bassaris*. A true relationship between the two species is thus out of the question." In 1901, however, Lankester, assisted by Lydekker, reanalyzed the evidence from external characters, dentition, skull, limbs and feet, and came to the conclusion that "*Aeluropus*" is a member of the Procyonidae, or raccoon family. They also divided that family into two subfamilies: (a) Procyoninae, containing the American genera *Procyon*, *Nasua*, and (b) Aelurinae, containing the Asiatic genera "*Ailurus*" and "*Aeluropus*":

In 1914 Bardenfleth, after an extended comparative analysis of the dental and osteological characters of *Ailuropus*, concluded that its resemblances to *Ailurus* were due to a convergent development of the molar teeth based on herbivorous diet and that its closest affinities were with the ursids of the *Hyaenarctos* group. In 1915 A. S. Woodward described a well-preserved skull of a giant panda, closely related to *Ailuropoda melanoleuca*, from a cave at Magok, Upper Burma, giving it the name *Aelureidopus baconi* and expressing the following opinion as to the relationships of "*Aeluropus*":

"It is so completely intermediate between the Procyonidae and the Ursidae, that it is sometimes placed in the one family, sometimes in the other; and its relationships to the Pliocene *Hyaenarctos* are so obvious, that it must doubtless be regarded as a somewhat modified survivor of



the common stock from which the Procyonidae and Ursidae have diverged. No closely related fossil forms, however, have hitherto been recorded; and the recent discovery of a skull of an allied extinct species is therefore of interest."

In 1923 Matthew and Granger, in describing the type of *Aeluropus fovealis* from the Pliocene of Szechuan, China, said: "The affinities of



Fig. 1. *Ailurus fulgens*. Side view of skull.  $\times 1$ .

*Aeluropus* appear to be with *Hyaenarctos*, as has been observed by Lydekker, Winge and other writers. Its systematic position appears to be clearly in the family Ursidae, although of a distinct subfamily from the true bears. Bardenfleth has presented the evidence for this view very clearly."

In 1932 in a valuable article on 'The Pandas or Cat-bears' Sowerby again directed attention to the many close resemblances between the giant panda and the little panda and concluded that "it would be more in keeping with the genetic facts of the case if the giant and little panda were placed together in a family by themselves, to which the name

Aeluridae might be given." On the other hand, Boule and Piveteau in their great work 'Les Fossiles' (1935, p. 778) refer *Aeluropus* to the Ursidae, placing it between *Indarctos* of the Siwaliks and *Arctotherium* of the Pliocene and Pleistocene of North and South America.

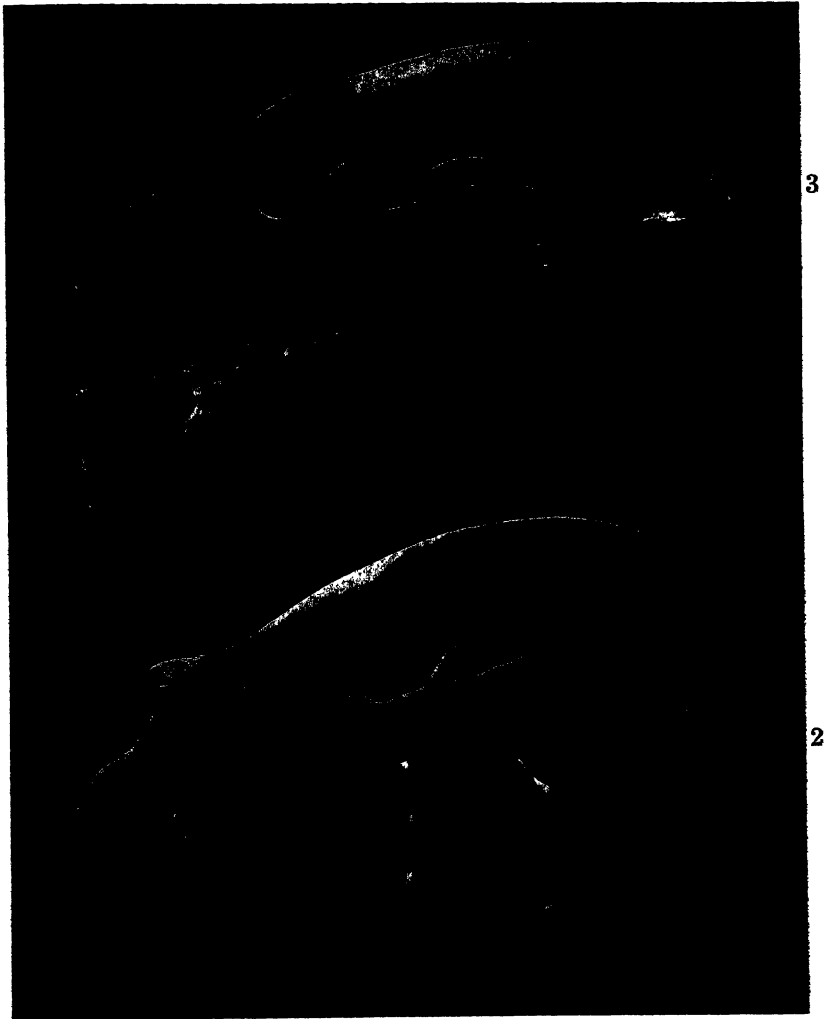


Fig. 2. *Ailuropoda melanoleuca*. Side view of skull.  $\times$  circa  $1/3$ .

Fig. 3. *Thalarcos maritimus*. Side view of skull.  $\times$   $1/3$ .

Thus, from the time of its discovery down to the present day the giant panda has been classified by most authors as a peculiar branch of the bears related to *Hyaenarctos*, but several authors have regarded it as a sort of intermediate between the bears and *Ailurus*, while Lankester and Lydekker held that it belongs with *Ailurus* as a subfamily of the Procyonidae but is related more remotely to *Hyaenarctos* and the Ursidae and still more remotely to *Canis*.

The preservation of the principal viscera of *Ailuropoda* by Mr. Donald Carter of the Dean Sage West China Expedition has made it possible for Mr. H. C. Raven to make comparisons with the viscera of other carnivores and has led him to conclude that Lankester and Lydekker were essentially correct in referring this genus to the Ailurinae. However, in view of the opposing judgments of other authors, it appeared desirable to make a new and independent analysis of the characters of the dentition and skull of *Ailuropoda* in comparison with those of fossil and recent canids, procyonids (including *Ailurus*), hemicyons and modernized bears. Through the kindness of Dr. H. E. Anthony, Curator of Mammals in this Museum, I have been privileged to study the several skulls of *Ailuropoda melanoleuca* secured by the Dean Sage West China Expedition, while Dr. Walter Granger has placed at my disposal an incomplete skull and nearly complete mandible of *Aeluropus fovealis*, together with a number of isolated teeth.

#### COMPARISON OF THE CHEEK TEETH OF *AILUROPODA* WITH THOSE OF THE *HEMICYONS* AND THE BEARS

After repeatedly studying and handling much fossil and recent material bearing on the problem in hand, I feel that it is no longer necessary to question the soundness of the late Dr. W. D. Matthew's general conclusions concerning the evolution and relationships of the main divisions of the order Carnivora. In his great memoir on the Carnivora and Insectivora of the Bridger Basin, as well as in other papers, Matthew showed that the Eocene family Miacidae was the parent family of all the modern dogs, bears, raccoons, civets, hyenas, cats, etc. In contrast with the typical creodonts, these Miacidae always had the chief cutting blades developed on the fourth upper premolar and the first lower premolar, which teeth are therefore called "the carnassials." The most primitive genera of the family had the carnassials quite large and highly cutting in character, much like those of a dog, but in several specialized derivatives of the family the shearing blade of the upper carnassial became reduced and the tooth showed a tendency to develop low conical

cusps. My studies (unpublished) on recent and fossil Canidae, Procyonidae, Ursidae, Mustelidae, Viverridae, etc., have also convinced me that Matthew was again right in regarding the following two divergent conditions as being entirely secondary: (a) the progressive enlargement and complication of  $p^4$  and  $m_1$ , culminating in the excessively shearing teeth of *Cryptoprocta*, the hyenas and the cats; (b) the degeneration and reduction of these teeth, in the bears, as well as in the Procyonidae. These divergent processes occur independently in different families.

The experience of palaeontologists suggests that when the systematic position of a mammal is in doubt a study of the patterns of the premolar crowns may yield points of high diagnostic value with regard to family relationships. We may therefore begin by comparing the premolars of *Ailuropoda* with those of the most primitive known representative of the bear series; this is the Pliocene *Hemicyon*, the dentition of which has been well described by Childs Frick (1926).

The second and third upper premolars of *Ailuropoda* (Fig. 4) are large and richly cuspidate teeth, whereas in *Hemicyon* and the bears the corresponding teeth are small, weak and degenerate. The upper "carnassial" ( $p^4$ ) of *Ailuropoda* is a very large complex tooth with three large cusps on its outer wall, a small antero-internal cusp and a very large postero-internal cusp; in *Hemicyon*, on the contrary,  $p^4$  retains much more of its primitive carnassial appearance, having a pronounced posterior blade, no parastyle cusp and only a small single internal cusp.

Similarly all the lower premolars of *Ailuropoda* (Fig. 9) are large and highly progressive teeth, while those of *Hemicyon* are small and somewhat degenerate as compared with those of the primitive Canidae. The lower carnassial ( $m_1$ ) of *Ailuropoda*, although disguised by secondary cusps, retains traces of its former carnassial function. It has, however, become much widened transversely, especially across the talonid. In *Hemicyon*, on the contrary, the lower carnassial ( $m_1$ ) retains most of its primitive dog-like character and is indeed anteroposteriorly elongate and compressed.

In brief, *Ailuropoda* is very widely separated from *Hemicyon* by its far more complex  $p^2$ ,  $p^3$ ,  $p^4$ , and  $p_2$ ,  $p_3$ ,  $p_4$ ,  $m_1$ . If we now compare *Hemicyon* with the bears, we see that its upper and lower premolars and  $m_1$  appear to afford an almost ideal starting-point for the more or less degenerate and specialized condition of these teeth in the bears. The main difference between *Hemicyon* and the typical bears is that in the former  $p^4$  is less reduced than in the late Tertiary and Pleistocene bears, where its small size is a character wholly foreign to all primitive Eocene

Miacidae and a relatively recent specialization not older than the initial anteroposterior elongation of  $m^1$ ,  $m^2$ .

$P^4$  of *Ailuropoda* agrees with that of *Hyaenarctos* in having a parastyle, but differs in having two large internal cusps instead of one. It is true that Winge (1895-96) and Bardenfleth (1914) tried to show by examination of the position of the roots that the inner cusps of the carnassial of *Ailuropoda* were homologous with those of *Ursus* and *Hyaen-*



Fig. 4. *Ailuropoda fovealis*. (?) Upper Pliocene, China.  $P^4$ - $m^2$ .  $\times 1/3$ .

Fig. 5. *Ailurus fulgens*. Under side of skull.  $\times 1$ .

*arctos*, not with those of *Ailurus*. According to this view the antero-internal cusp of  $p^4$  in *Ailuropoda* represents a new upgrowth from the cingulum, while the larger obliquely placed cusp represents the backwardly displaced main internal cusp of the carnassial of the bears. But

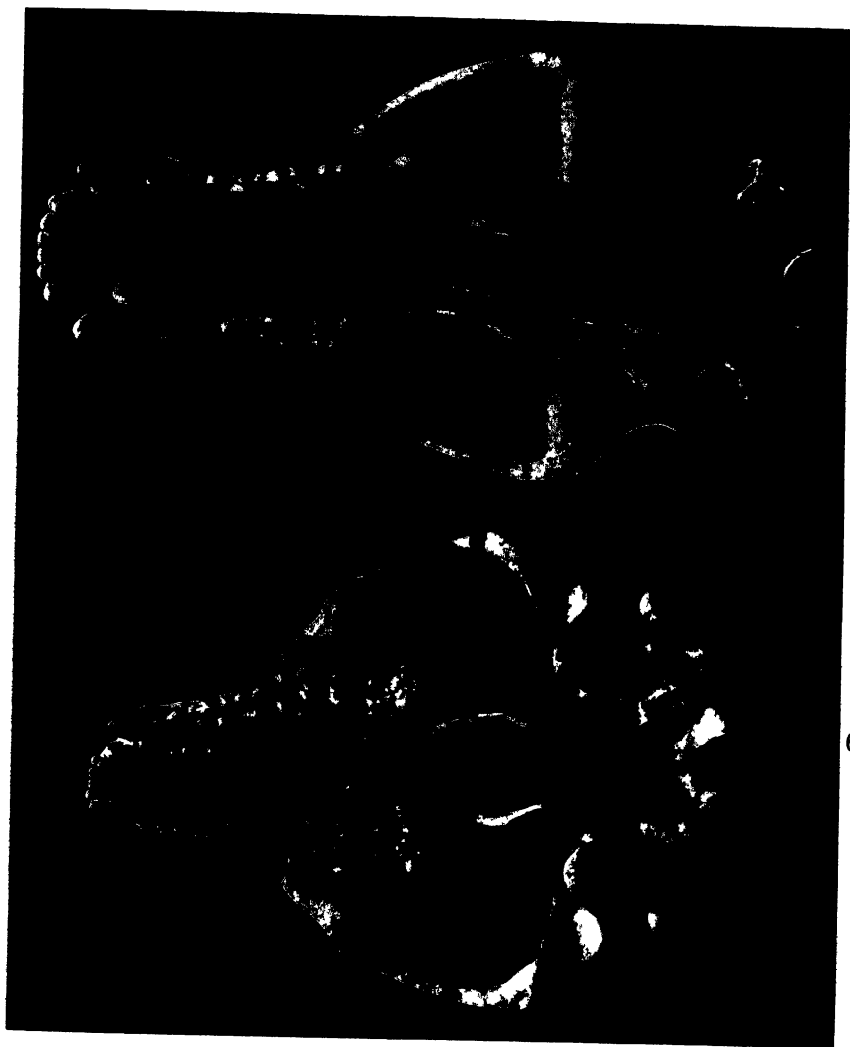


Fig. 6. *Ailuropoda melanoleuca*. Under side of skull.  $\times 1/3$ .

Fig. 7. *Thalarctos maritimus*. Under side of skull.  $\times 1/3$ .

after a careful review of the facts I conclude, on the contrary, that the postero-internal cusp of  $p^4$  of *Ailuropoda* is fully homologous with the corresponding cusp in *Ailurus* and *Parailurus*, but not at all homologous with the sole internal cusp of *Hyaenarctos* and the bears, which is progressively displaced backward. These differences alone would be insufficient to exclude *Ailuropoda* from descent from *Hyaenarctos*, but taken in connection with many other points they serve to emphasize the conclusion that the ancestry of *Ailuropoda* must be sought elsewhere than in *Hyaenarctos*, which is assuredly related on the one hand to *Hemicyon* and on the other to the ancestors of the short-faced bears, with which it is connected by the genera *Indarctos* and *Ursavus*.<sup>1</sup>

The upper molars ( $m^1$ ,  $m^2$ ) of *Ailuropoda* (Figs. 4, 6) are remarkable for their relatively immense size and for the rich development of "secondary polyisomerites" in the form of small accessory tubercles on the surface of their crowns. In these features they are far more specialized than  $m^1$  and  $m^2$  of *Hemicyon*, which are much nearer to the primitive dog-like condition. At first sight the upper molars of *Ailuropoda* do indeed suggest those of typical bears, but they are much wider, more tuberculated and less elongated anteroposteriorly. The first upper molar of *Ailuropoda* differs from those of *Hyaenarctos*, *Lydekkerion* and *Indarctos*, which are well figured by Frick (1926), in its greater width, rich tuberculation, very large proto- and meta-conules and enlarged internal cingulum. In the three last-named genera the first upper molar seems to be approaching that of the Malayan bear (*Helarctos malayanus*).

Both  $m^1$  and  $m^2$  of *Ailuropoda* differ from those of the short-faced extinct bears (*Arctotherium*) in important characters: they are decidedly wider transversely and shorter anteroposteriorly, their para- and meta-cones are on the extreme outer border of the crowns instead of being further in toward the middle of the tooth, their internal cingulum is massive and crenulated instead of being nearly vestigial.

The second upper molar ( $m^2$ ) of *Ailuropoda* is much less elongate than that of the typical bears, but more elongate than that of either *Hyaenarctos* or *Indarctos*; it is distinguished from the corresponding tooth in all the bears, however, by the presence of a double row of vigorously developed cuspsules between the inner surface of the reduced paracone and the metacone, as well as by the presence of a large "meta-

<sup>1</sup> Childs Frick, whose excellent work on the Hemicyoninae (1926) supplies abundant evidence of the intermediate position of these genera between dogs and bears, yet prefers the idea that the lines represented by *Canis*, *Amphicyon*, *Procyon* and *Ursus* all run back quite independently to the Oligocene. This is partly because he seems not to have realized that the premolars of bears are reduced and degenerate, just as the enlargement of their upper molars is secondary, and that, as Matthew maintained, the large carnassials and small molars of the earliest dogs and miacids represent the primitive condition for all Arctoidea.



Fig. 8. *Ailurus fulgens*. Lower jaw.  $\times 1$ .

Fig. 9. *Ailuropoda melanoleuca*. Lower jaw.  $\times 1/3$ .

Fig. 10. *Thalarcos maritimus*. Lower jaw.  $\times 1/3$ .



conule" and of very numerous small tubercles on the surface of the transversely widened talon. The development of a large talon on the posterior side of  $m^2$  occurs independently in certain mustelids and in the last upper molars of the pigs. Hence the somewhat bear-like general appearance of the second upper molar of *Ailuropoda* is in itself not necessarily evidence of family relationship.

$M^2$  of *Ailuropoda* as compared with  $m^2$  of *Arctotherium* lacks the sudden constriction in the outer wall behind the metacone (which constriction is characteristic of bears) and the surface of the transversely wide and massive talon is covered with many small but prominent tubercles, whereas in the  $m^2$  of *Arctotherium* the tuberculation is sparse, minute and indefinite.

The second lower molar of *Ailuropoda* differs widely from those of all the bears and their allies in its much greater width, in the presence of high meta- and ento-conid transverse crests and in the presence of small polyisomerous cuspsules on several parts of the crown.

The third lower molar of *Ailuropoda* is wider than that in typical bears and its crown is covered with many small tubercles.

Thus the cheek teeth of *Ailuropoda* differ widely from those of the bears in the following conspicuous features:

	<i>Ailuropoda</i>	Typical Bears
Upper $p^2$ , $p^3$	Large and progressively complex	Very small and degenerate
Lower $p_2$ , $p_3$	Large and progressively complex	Very small and degenerate
Upper carnassial ( $p^4$ )	Of large size with three large external cusps and very large postero-internal cusp	Of small size with two external cusps and no postero-internal cusp
Lower $p_4$	Large with trilobed blade flattened externally	Small, degenerate, crown with single tip
Lower carnassial ( $m_1$ )	Large, robust, with very large and distinct paraconid and metaconid	Much compressed, with weak paraconid and small metaconid
Upper $m^1$	Very large, squarish, with large "proto-" and "meta-"conules and massive internal cingulum	Smaller, elongate, without "proto-" and "meta-"conules, reduced internal cingulum
Upper $m^2$	Very massive, with broad talon, stout internal cingulum and many bead-like tubercles	Elongate, with narrow talon, slight internal cingulum and somewhat vermiculate surface

	<i>Ailuropoda</i>	Typical Bears
Lower $m_2$	Massive, broad, with high transverse meta- and entoconid crests and coarse tubercles. Trigonid and talonid subequal	Slender, compressed, with cingulum-like entoconid; trigonid and talonid asymmetric
Lower $m_3$	Large, short, wide, surface coarsely tuberculate	With oval surface, delicately sculptured

In general the hemicyons, as figured by Frick, in spite of retaining relatively large carnassials (an obviously dog-like and primitive character), definitely align themselves between the primitive dogs on the one hand and the bears on the other, and show no demonstrable tendency in the direction of *Ailuropoda* except a secondary widening of the molars in *Arctotherium*. In *Hyaenarctos* the large size of the carnassial, as compared with the molars, is a point of resemblance with the primitive dogs and miacids, while in *Indarctos* and *Ursavus* the increasing length of the molars points the way to the sharp degeneration of the premolars in the modernized bears.

The dentitions of *Arctotherium* and *Paracatherium* closely connect themselves with those of the *Hyaenarctos-Indarctos* group and present only superficial resemblances to the dentition of *Ailuropoda* joined with many significant differences. Therefore, so far as the evidence of the dentition is concerned, we may look for the ancestry of *Ailuropoda* neither among the bears themselves nor among the near-ancestors and relatives of the bears, such as *Indarctos*, *Hyaenarctos* and *Arctotherium*.

Still greater are the differences that separate the dentition of *Ailuropoda* from those of the short-faced extinct dogs, such as *Borophagus* as figured by Matthew and Stirton (1930). Hence I can find in the foregoing comparative study of the dentition of *Ailuropoda* no support whatever for the conclusion of various authors who have classified it with the bears and particularly in the neighborhood of *Hyaenarctos*, nor even for the idea that *Ailuropoda* is any sort of intermediate between bears and procyonids.

#### COMPARISON OF THE CHEEK TEETH OF THE GIANT PANDA WITH THOSE OF *AILURUS* AND OTHER PROCYONIDS

It is perhaps not always realized even by palaeontologists that, in many families of vertebrates, structurally ancestral stages of any given horizon often persist to later periods and are the contemporaries of their more or less highly modified derivatives. This truth, which is of far-reaching and manifold significance, is nowhere better documented than

in the existing families of the fissipede Carnivora. Among the Procyonidae it was long since recognized by Wortman and Matthew (1899) that the existing genus *Bassariscus* has retained almost completely the ancestral canid characters of the upper and lower carnassials and molars, except that the metastyle shear of  $p^4$  is reduced and that there is a small internal cingulum bearing a low postero-internal cusp. This is the first step toward the partial molarization of  $p^4$ , which is conspicuous in increasing degrees in *Nasua*, *Procyon* and *Ailurus*. In another direction *Bassariscus* is the structural ancestor of *Bassaricyon*, at least in its dentition, and the latter, with its rounded low-cusped  $p^4$ ,  $m^1$  and  $m^2$ , points the way to the flat-topped cheek teeth of *Cercoleptes* (*Potos*).

Likewise, *Bassariscus* may be regarded as the structural ancestor of *Procyon*, which, along with greatly increased size, has acquired more massive jaws;  $p^4$  of *Procyon* has its metastyle blade greatly reduced, its "hypocone" (tetartocone) and main internal "protocone" (= deuterocone) much emphasized; its molars have enjoyed a marked increase in anteroposterior diameter, the main cusps having become large and rounded pyramidal. Similarly in its lower teeth, the carnassial ( $m_1$ ) of *Procyon* has reduced its sectorial and increased its crushing features, while  $m_2$  has become elongate and tubercular. *Nasua* is a long-snouted relative of *Procyon* with deceptively secondary equalization of the main molar cones. Its  $p^4$ , however, does supply a structural stage in the evolution of  $p^4$  of *Ailurus*. *Ailurus* is much more advanced in its cheek teeth than any other existing procyonid but, as will be shown below, its cranial characters securely connect it with that family.

Turning to the fossil forms, *Phlaocyon* (Wortman and Matthew, 1899) is near the racoon but more primitive, while the related *Aletocyon*, as noted by Romer and Sutton (1927) shows several significant suggestions of *Ailurus* and tends to tie in that genus more securely with the Procyonidae.

*Ailurus*, in turn, is almost the direct structural ancestor of *Ailuropoda*, especially with regard to nearly all those features in which the latter contrasts widely with the bears. These comparisons may be conveniently summarized as follows:

	<i>Ailurus</i>	<i>Ailuropoda</i>
Upper $p^2$ , $p^3$	Crowns large and progressively complex	Much larger and more elongate but with closely comparable cusps
Lower $p_2$ , $p_3$	Large and progressively complex, compressed, tri-	Much larger and more elongate but with closely com-

	<i>Ailurus</i>	<i>Ailuropoda</i>
	cuspid, with shearing surface on outer side	parable cusps and similar shearing surfaces
Upper carnassial ( $p^4$ )	Of large size, with three large external cusps, two large internal cusps and an internal cingulum cusp	Much more elongate; postero-internal cusp greatly enlarged; internal cingulum cusp between two main internal cusps
Lower $p_4$	Elongate, outer face flattened and tending to become tricuspid	Strikingly similar in ground plan but with more advanced tricuspid arrangement of buccal cusps
Lower carnassial ( $m_1$ )	Large, robust, with very large conical paraconid and hypoconid; trigonid and talonid subequal	Much larger and with derived crown pattern
Upper $m^1$	Very large and wide, with four large main cusps; a parastyle, mesostyle and small metastyle; a large internal cingulum	Much larger, squarish, with reduced styles, large proto- and meta-conules and robust crenulate internal cingulum
Upper $m^2$	Smaller than $m^1$ , but otherwise essentially similar	More elongate anteroposteriorly, with huge talon; crown with four main cusps and numerous secondary bead-like tubercles
Lower $m_2$	Elongate, narrow, with opposite proto- and metaconids; double metaconid and large hypoconulid	Widened, with subequal trigonid and talonid opposite proto- and metaconids, no hypoconulid and coarsely tuberculated crown
Lower $m_3$	Absent	Present, robust; shortened anteroposteriorly and irregularly tuberculated

Long experience with other anteroposteriorly elongate tuberculated molars in other families of mammals (especially in various herbivorous phyla) leads to the conviction that the striking and peculiar features of the second and third upper and lower premolars that are common to *Ailurus* and *Ailuropoda* far outweigh the conspicuous differences in the molars. These appear to be correlated with the highly specialized food habits of *Ailuropoda*, which cuts up bamboo leaves and stems and grinds them into small pieces. Even the presence of a third lower molar in *Ailuropoda* (Fig. 9) and its absence in *Ailurus* (Fig. 8) does not necessarily eliminate *Ailurus* from relatively close relationship to the direct



cone of  $m^2$ . Thus it seems not unlikely that the so-called  $m_3$  of *Ailuropoda* has appeared in adjustment to the enormous development of the talon of  $m^2$ . This hypothesis is not so far-fetched as it may seem to many palaeontologists, for it is fortified by the very numerous point to point agreements between *Ailurus* and *Ailuropoda* in many parts of the skull, as shown below. Moreover, A. E. and H. E. Wood (1933) have assembled cogent evidence for the view that in modern dogs a "third" upper molar does occasionally appear secondarily.

Unexpected support for the conclusion that the dentition of *Ailuropoda* is in general a structural derivative of that of *Ailurus* is supplied by the dentition of *Parailurus anglicus* as figured and described by Schlosser (1899). Here the upper "carnassial" ( $p^4$ ) has become more elongate anteroposteriorly as compared with that of *Ailurus* and the entire crown pattern is distinctly approaching that of *Ailuropoda*. The unmistakably intermediate condition of the  $p^4$  of *Parailurus* between those of *Ailurus* and *Ailuropoda* definitely disposes of Winge's suggestion (as stated by Bardenfleth) that the large postero-internal cusp of  $p^4$  of *Ailuropoda* is not homologous with the corresponding cusp of *Ailurus*.

The first and second upper molars of *Parailurus*, although somewhat more elongate than those of *Ailurus*, do not yet show the breaking-up of the surface of the crown into secondary polyisomeres. The lower "carnassial" ( $m_1$ ) is fairly suggestive of that of *Ailuropoda*.  $M_2$  is large and progressive, with a small hypoconulid, which articulated with the posterior part of  $m^2$ , as does the hypoconulid of  $m_2$  of *Ailurus*.

In conclusion, although the molars of *Ailuropoda* differ from those of *Ailurus* in superficial appearance, to such an extent indeed that Winge and Bardenfleth would not allow any close relationship between these genera, yet the differences between them, especially the greater complexity of the upper molar crowns in *Ailuropoda* and their anteroposterior elongation, are somewhat similar to the differences between the multi-tuberculate upper molars of progressive Suidae and the quadrituberculate molars of their bunodont ancestors. In other words, such differences seem to be correlated with differences in food habits.

#### COMPARISON OF THE MANDIBLE AND SKULL OF *AILUROPODA* WITH THOSE OF OTHER ARCTOID CARNIVORA

When we arrange the skulls of various arctoid carnivores in side view on the Frankfort plane, we see that in *Ailurus* (Fig. 1) the tooth row is curved somewhat upward; in *Ailuropoda* (Fig. 2) it is nearly horizontal,

while in the bears it is inclined downward. Typical dogs have the temporo-mandibular articulation only a little above the general level of the occlusal plane, whereas in *Ailurus* this articulation is well elevated above the occlusal plane. As a consequence of the backward extension of its molars and the huge size of its temporal fossa, the coronoid process is of great vertical extent, its anterior border forms a forwardly inclined sigmoid curve and its masseteric fossa is exceptionally deep and constricted. In *Ailuropoda* (Fig. 6), in which the tooth rows have become more than twice as long anteroposteriorly as they are in *Ailurus* (Fig. 5), the temporo-mandibular articulation has been displaced to the rear, the extreme constriction of the masseteric fossa (Fig. 2) has been rectified and the sigmoid curvature of the anterior border of the coronoid process reduced. The backward displacement of the glenoid socket of the squamosal in *Ailuropoda* has likewise decreased the excessive up-bowing of the zygomatic arch, which is so conspicuous in *Ailurus* (Fig. 1); but in all these parts *Ailuropoda* differs widely from the bears (Figs. 3, 7) and its conditions are most readily derivable from those seen in *Ailurus*. A conspicuous difference between *Ailuropoda* and *Ailurus* is found in the extreme heaviness and density of the jaw bones of the former; but this is evidently due to some obscure physiological difference involving calcium metabolism and the endocrine glands.

In *Ailurus* (Fig. 1) the hook-like angle of the mandible is on a plane far above that of the lower border of the mandible. The same is true in *Ailuropoda* (Fig. 2), but here the posterior displacement of the articular facet (glenoid) has further emphasized the reduction of the angle. In the bears (Fig. 3) both the condyle and the angle are on a lower plane and the angle is not reduced. The postglenoid process of the squamosal in *Ailurus* (Figs. 1, 5) extends far downward and forward below the level of the outer part of the mandibular condyle, so as to articulate with a downward prolongation of the inner part of that condyle. The result is a peculiar scroll-like temporo-mandibular articulation which is most nearly paralleled in the Mustelidae. In *Ailuropoda* (Figs. 2, 6) the conditions in this region are directly derivable from those in *Ailurus*, with the addition that the backward displacement of the glenoid articulation has caused the postglenoid process to overlap and fuse with the inferior surface of the tympanic bulla. The bulla of *Ailuropoda* (Fig. 6) differs from that (Fig. 5) of *Ailurus* (which is inflated) by being small and deflated, as it is in many large mammals as compared with their smaller relatives.

In general the masticatory part of the skull of *Ailuropoda* is wholly

unlike the bears and almost immediately derivable from that of *Ailurus*, the leading factors being the great increase in absolute size of the entire animal, the relative increase in the backward extension of the molars and their further evolution away from the simple quadrituberculate toward a coarse, mill-like type covered with small tubercles. It is therefore not surprising to learn from Mr. Carter that the food of *Ailuropoda* consists chiefly of leaves and stems of bamboo. Thus *Ailuropoda*, although a carnivore by ordinal heritage, is assuming the masticatory habitus of a herbivore, whereas its structural ancestor *Ailurus* has retained a more omnivorous habitus.

We may therefore sum up this part of our analysis in the following table:

	<i>Ailurus</i>	<i>Ailuropoda</i>	Bears
Muzzle	Short	Very short	Usually long
Bony forehead	Of moderate width	Very narrow	Very broad
Maxilla in side view	Inclined slightly upward	Inclined slightly upward	Inclined downward
Zygomatic arches	Sharply bowed outward and downward	Less sharply bowed outward and downward	Elongated
Alveolar pouches of maxillae	Conspicuous in top view of skull (Fig. 12)	Very conspicuous in top view (Fig. 13)	Not seen in top view (Fig. 14)
Sagittal crest	Moderate	Very high, elongate posteriorly	Relatively low
Lower border of mandible	Strongly convex	Convex	Flat
Level of condyle	Far above plane of cheek teeth	Above cheek teeth	On or below level of cheek teeth
Angle of mandible	Slightly inflected	Strongly inflected	Not inflected
Coronoid process	Very high with strongly convex anterior border inclined forward, tip produced backward	High, convex anterior border, tip produced sharply backward	Low and broad with sloping anterior border
Mandibular condyle	Scroll-like, much extended postero-medially	Scroll-like, with large postero-medial extension	Transverse cylindrical, with but little if any postero-medial extension
Postglenoid process of squamosal	High, internally placed	High, internally placed (relatively near to midline) and far to the rear	Low, far out from midline and displaced forward



	<i>Ailurus</i>	<i>Ailuropoda</i>	Bears
Posterior base of postglenoid process	Not overlapping tympanic bone	Strongly overlapping tympanic bone and fused with it	Sharply separated from tympanic bone
Mastoid process	Small, rounded, directed outward	Very large, projecting outward, downward and forward below tympanic	Short, thick
Paroccipital process	Longer than mastoid process	Much shorter than mastoid process	Short

Lankester (1901), correctly as it seems to me, recognized and interpreted the striking agreements in the mandible between *Ailurus* and *Ailuropoda* and the wide differences of the latter from the bears in this region. Bardenfleth, on the other hand, attributed the fundamental resemblances between *Ailurus* and *Ailuropoda* to convergence but accepted the general resemblances between the upper molars of *Ailuropoda* and those of the Ursidae as indicative of family relationship.



Fig. 12. *Ailurus fulgens*. Upper side of skull.  $\times 1$ .

Passing to a comparison of those parts of the skull which are more closely related to the brain and cranial nerves, we find that in *Ailurus* what may be called the optic funnel (Fig. 1) leading back from the orbit

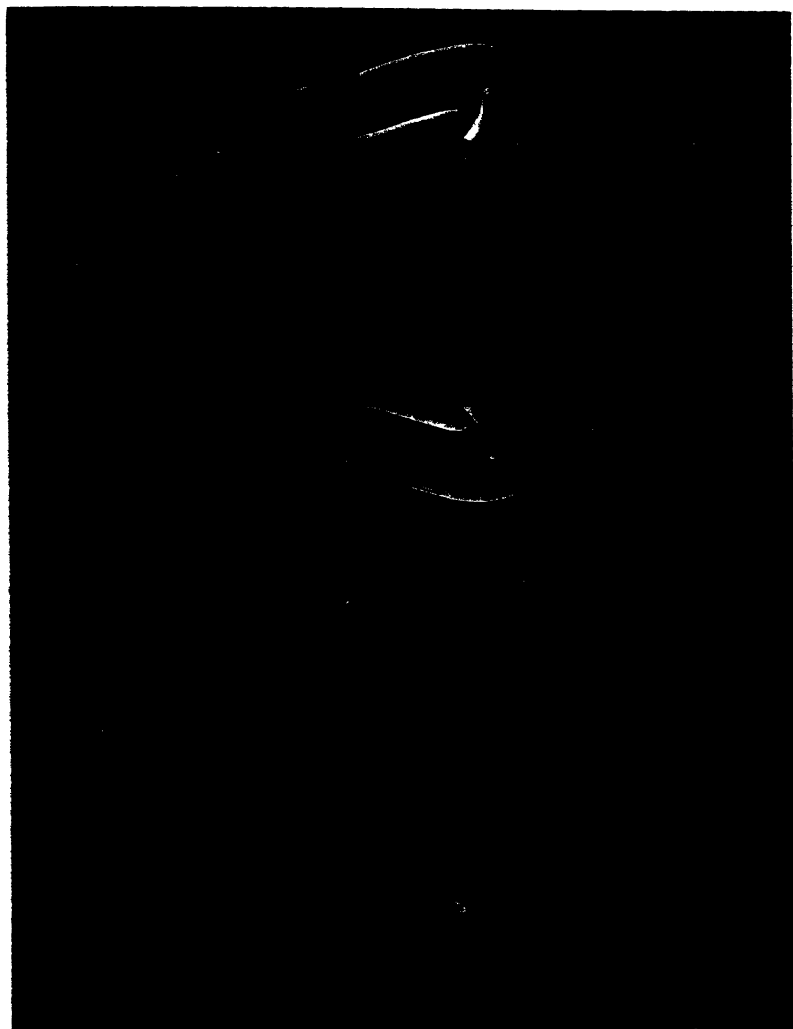


Fig. 13. *Ailuropoda melanoleuca*. Upper side of skull.  $\times 1/3$ .

Fig. 14. *Thalarctos maritimus*. Upper side of skull.  $\times 1/3$ .

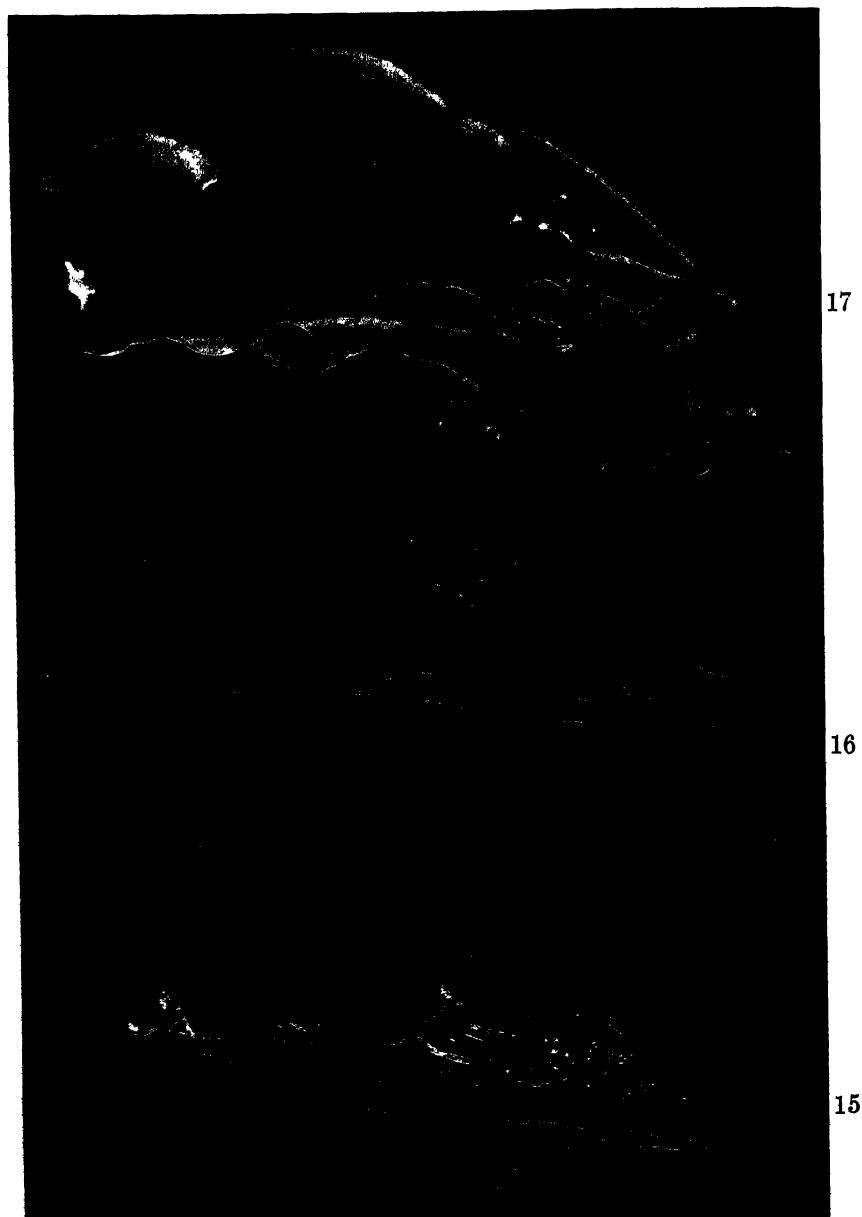


Fig. 15. *Alopex* sp. Left half of skull, mesial aspect. Not to scale.  
Fig. 16. *Procyon*. Left half of skull, mesial aspect. Not to scale.  
Fig. 17. *Ailurus*. Left half of skull, mesial aspect.

to the optic foramen is bounded by a faint oblique ridge which culminates above in the delicate postorbital process. In *Ailuropoda* (Fig. 2) little if any trace of this ridge is visible; in the bears (Fig. 3), including *Arcto-*

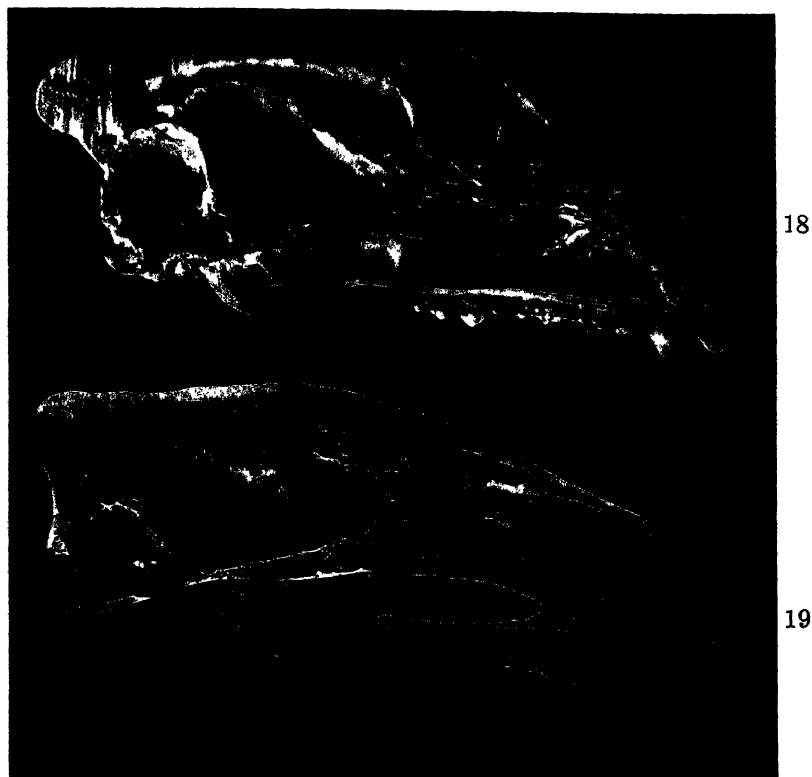


Fig. 18. *Ailuropoda*. Left half of braincase, mesial aspect.

Fig. 19. *Thalarctos*. Left half of braincase, mesial aspect.

*therium*, on the contrary, this ridge is greatly emphasized and is continued backward and downward laterally to the foramen lacerum anterius.

Longitudinal bisection of the cranium of a series of representative arctoids yields further evidence that *Ailuropoda* is more closely related to *Ailurus* and the Procyonidae than to the bears. Figures 15 to 19

indicate that in the fox and polar bear the tentorial plane is sharply directed backward and the chamber for the cerebellum is relatively small. However, this condition is much more pronounced in the polar bear (*Thalarctos maritimus*) (Fig. 7) than it is in the black bear (*Euarctos americanus*). *Ailuropoda* (Fig. 9) is much more specialized than the bears in the extreme shortness of the base of the occiput, the distance from the basion to the posterior clinoid process being about fifteen per cent of the basal length (basion to prosthion), whereas in both *Euarctos americanus* and *Ailurus* it is about twenty-four per cent.

Another mark of specialization in *Ailuropoda* is the virtual disappearance of the fossa subarcuata, which remains widely open on the dorsum of the petrous bone in fox, *Ailurus*, and bears but is indistinct in an aged *Procyon*.

In *Ailuropoda* (Fig. 13) the medial part of the tentorium is more nearly vertical and the cerebellar chamber is more expanded dorsally. In *Ailurus* also (Fig. 12) the tentorium and cerebellar cavity are expanded dorsally more than in *Procyon* (Fig. 16) and much more than in the fox (Fig. 15). The cavity of the cerebrum in *Ailuropoda* is relatively short, high posteriorly and sharply sloping anteriorly, while that in the bears (Fig. 14) is relatively longer with less depressed frontal wall. In *Ailurus* the frontal pole of the brain is expanded dorso-anteriorly, as it is also in *Procyon* and the fox; but in these animals the frontal sinus is of moderate size, whereas in *Ailuropoda* it has grown far backward above the cerebellum, extending also vertically but limited laterally by the powerful anterior fasciculi of the temporal muscle, so that externally the forehead is extremely narrow. In the bears, on the contrary, the frontal sinuses expand laterally, producing the characteristically broad forehead. The olfactory fossa in *Ailuropoda* is relatively very small, whereas in bears it is larger. In *Ailurus* the olfactory fossa is relatively larger than in *Ailuropoda*, more as in *Procyon*, but not nearly so large as in the fox.

In *Ailuropoda* the large maxillo-turbinate scrolls do not seem to present any striking differences from those of either the bears or *Ailurus*, which all alike conform to the "arcoid" plan. The nasal chamber as a whole is shorter and higher in *Ailuropoda* and *Ailurus* than in the bears.

In *Ailuropoda* the internal opening of the sphenopalatine foramen is somewhat fissure-like and faces forward. In the bears it is a very large oval window, which looks more directly inward. In *Ailurus* the conditions foreshadow those in *Ailuropoda*.

Table I.—Comparative skull measurements (in millimeters)

	<i>Ailuurus</i>	<i>Ailuropoda</i>				<i>Paraclotherium</i>	<i>Tremarctos ornatus</i>	<i>Helarctos malayanus</i>	<i>Euarctos americanus</i>	<i>Ursus maritimus</i>
		Three Females			Male					
(1) Skull, length (pmx-cond.) (L)	95	255	247	247		325	194	197	286	307
			av. 249		258					
(2) Transverse zygomata (B)	71	208	196	204		218	115	139	183	172
			av. 202		214					
I. Index $\frac{B \times 100}{L}$	74.7		85		83	67	59	70	64	56
(3) Width of forehead (in front of postorb. proc.) (wf)	20	55	52	49	54	101	48	53	76	75
			av. 52							
II. Index $\frac{wf \times 100}{v}$	22		20.9		20.9	31	24.7	27	26	24.4
III. Index $\frac{wi \times 100}{B}$	28		25.7		25.2	46	41.5	39	41.5	43.6
(4) Length, midpoint (between postglenoid proc.) to basion 1 (pgl)	19	40	37	38		60	43	49	71	72
					39					
IV. Index $\frac{l(pgl) \times 100}{L}$	20		15		15	18	22	25	24	23
(5) Length mandible, cond. to inc. (lmd)	72		200			...	137	132	196	206
(6) Height, tip coronoid to bot- tom of mandible below angle (hmd)	39	115	116	120		...	63	63	98	80
			av. 117		118					
V. Index $\frac{(hmd) \times 100}{(lmd)}$	54		58			...	43	47	50	39
(7) Height of head when resting on fore part of mandible (H)	66	204	208	200		...	110	105	143	121
			av. 204		216					
VI. Index $\frac{H \times 100}{L}$	69		81		84	...	56	53	50	39

N. B.—It will be seen that in nearly all its proportions the skull of *Ailuropoda* is nearer to that of *Ailuurus* than to those of any of the bears.

Doubtless the analysis could be carried into additional details but enough has been said to indicate that the architecture of the inner aspect of the brain case of *Ailuropoda* is not inconsistent with the con-

clusion that this genus is simply a specialized member of the subfamily Ailurinae, and that the bear-like character of the maxillo-turbinate scrolls is shared with *Ailurus* and *Procyon*.

Some palaeontologists will no doubt prefer to treat the Ailurinae (including *Ailuropoda*) as a separate family. In that case we should have to split the Procyonidae into the Bassariscaidae, Cercoleptidae, Procyonidae (*sensu strictu*) and Ailuridae, but this would only disguise the fact that *Ailurus* in the deeper characters of its brain case is related to *Procyon* rather than to any known canids or ursids.

My conclusions are briefly as follows: (1) that Lankester and Lydekker were right in referring *Ailuropoda* to the subfamily Ailurinae of the Procyonidae; (2) that such resemblances as it shows to the bears in the dentition are due largely to convergence; (3) that *Ailurus* is a specialized procyonid; (4) that all the bears (including *Hyaenarctos*) have been derived from a branch of the primitive canids which was quite distinct from that which gave rise to the procyonids, including *Ailuropoda*.

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## APPENDIX

Through the great kindness of Dr. Gerrit S. Miller of the United States National Museum, I have had the privilege of studying a young skull determined as *Ailuropus melanoleucus*, from Szechuan (U. S. Nat. Mus. No. 259076), in which the cranial sutures are for the most part wholly open. All the permanent cheek teeth are in place but only the earliest beginnings of wearing facets are seen on the cutting edges of the teeth.

The numerous points of special resemblance to *Ailurus* noted in the



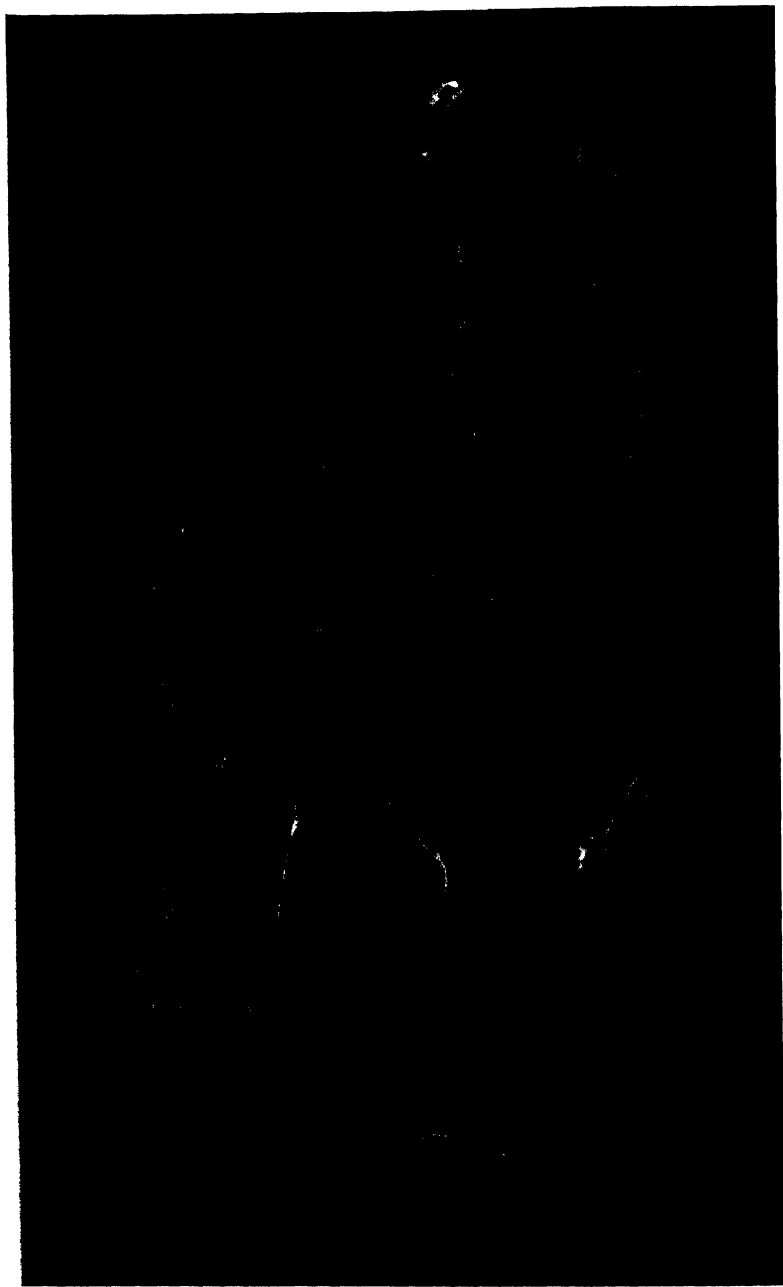


Fig. 20. *Añuropoda melanoleuca*. Young adult skull, showing sutures. Side view.  
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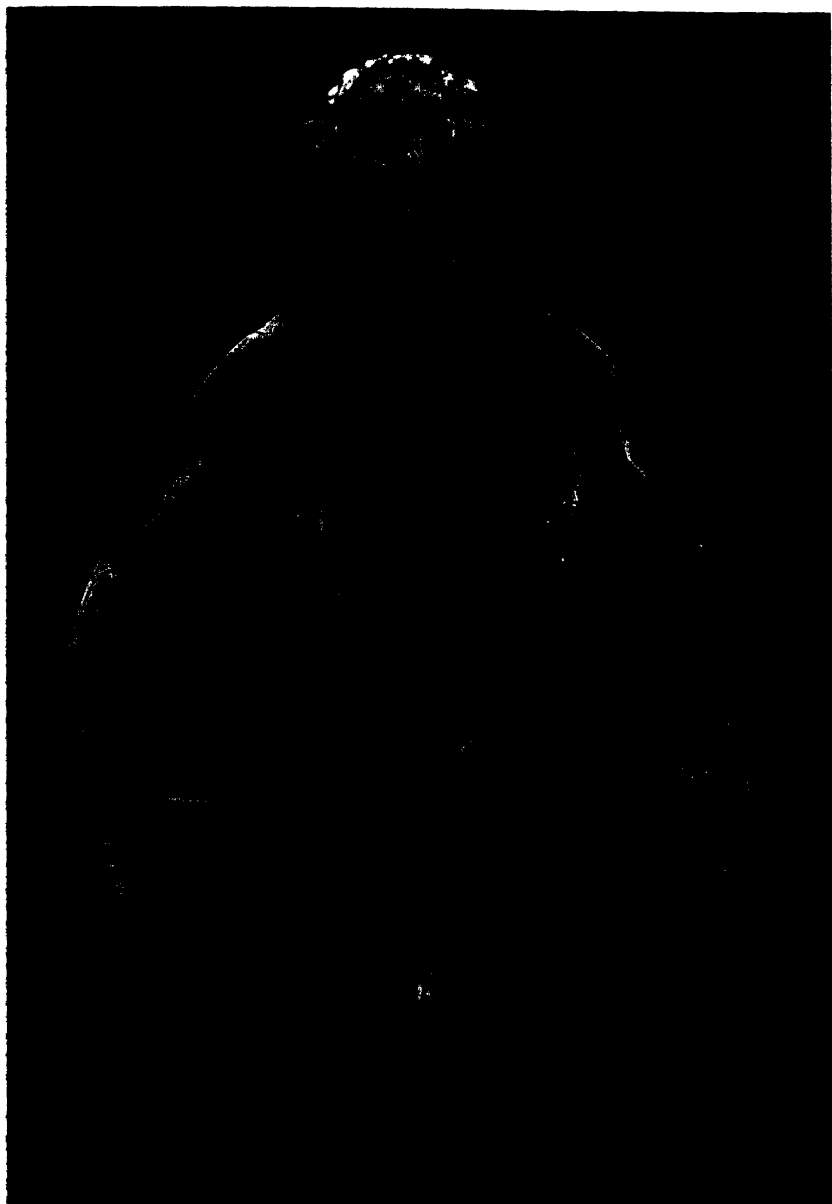


Fig. 21. *Ailuropoda melanoleuca*. Young adult skull, showing sutures. Top view.  
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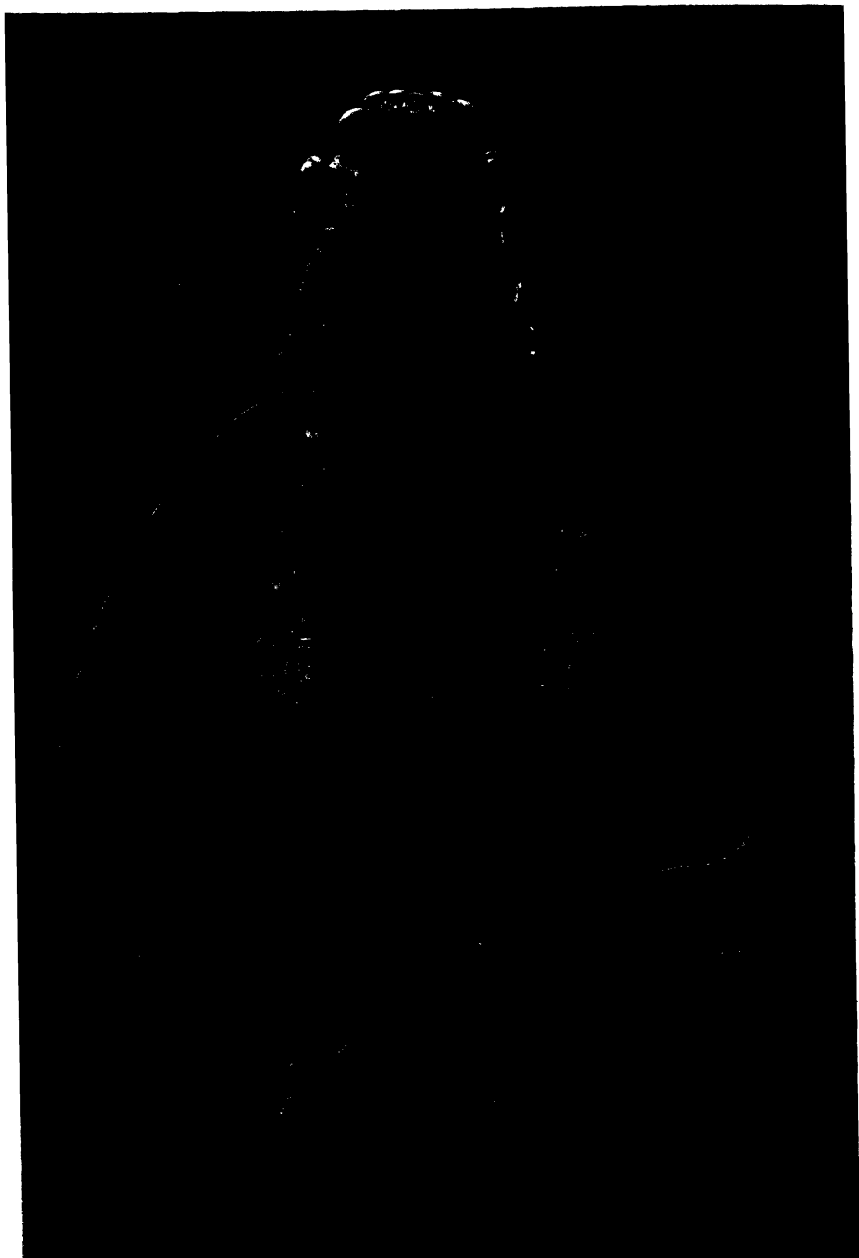


Fig. 22. *Ailuropoda melanoleuca*. Young adult skull, showing sutures. Under side.  
U. S. Nat. Mus. No. 259076.

foregoing paper are all sustained and emphasized by the conditions in the young skull. Sharp contrast with the bears is seen in the region immediately behind the floor of the orbit, where the great maxillary alveolar pouches, already conspicuous in *Ailurus*, have now grown medially, nearly closing the fissure between themselves and the vertical plate of the palatine and forming with the latter a secondary contact posteriorly.

In the bears, on the contrary, the alveolar portions of the maxilla are very narrow transversely, but little produced behind the floor of the orbit and do not form a *secondary* contact with the posterior part of the palate. In the occipital region the young skull of *Ailuropoda* offers many resemblances to that of *Ailurus*, especially in its great width and lowness, in the form and direction of the paroccipital process and in the shortness of the mastoid process, which extends downward, outward and forward to a much less degree than in the old skulls. The fusion of the postglenoid with the tympanic has barely begun and the spout of the tympanic, although reduced, is still recognizable.

There is no median anterior palatine foramen either in *Ailuropoda* or *Ailurus*, whereas in the bears (including *Arctotherium*) this median foramen is conspicuous. The chief cranial foramina compare closely with those of *Ailurus*.

The lacrymal, however, is greatly reduced in size and confined within the orbital rim, as in both *Ailurus* and the bears.<sup>1</sup> In both *Ailurus* and *Ailuropoda* the lacrymal is separated from the orbital wall of the palatine by the alveolar extension of the maxilla. At least in some bears the primitive lacrymal-palatine contact is retained; in others (e.g., *Helarctos*) the palatine seems to be excluded from contact with the lacrymal by the maxilla. In both *Ailuropoda* and the bears the lacrymal foramen is double.

<sup>1</sup> See also Gregory, William K., 1920. 'Studies in comparative myology and osteology, No. IV.—A review of the evolution of the lacrymal bone of vertebrates with special reference to that of mammals.' Bull. Am. Mus. Nat. Hist., XLII, Art. 11, 95-263.



# AMERICAN MUSEUM NOVITATES

Number 879

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

October 6, 1936

## SOME TRANSITIONAL ELASMOBRANCHS CONNECTING THE CATULOIDEA WITH THE CARCHARINOIDEA

By E. GRACE WHITE

While engaged in the revision of the Order Galea outlined in my 'A Classification and Phylogeny of the Elasmobranch Fishes' recently published (Amer. Mus. Novitates No. 837, 1936), I came upon several species which aided materially in establishing the transition from the Catuloidea to the Carcharinoidea. These species have been difficult to classify because of their transitional nature, and have been assigned to various genera and have received various names in the recent literature. It is to settle these disputed points that this paper is presented.

The species in question are *Catulus torazame* of Tanaka, 1908, *Calliscyllium venustum* of Tanaka, 1912, *Atelomycterus marmoratus* of Garman, 1913, and *Triakis scyllium* of Müller and Henle, 1841. In order to establish comparisons I have selected three closely allied species whose characteristics do not vary from the established definitions: *Catulus retifer* of Garman, 1913, *Halaehurus burgeri* of Gill, 1861, and *Carcharinus milberti japonicus* of Schlegel, 1850. *Carcharinus* is a genus more familiarly known as the *Carcharias* of Cuvier, 1817, but Garman has recognized the priority claim of the name *Carcharinus* Blainville, 1816, and I have followed Garman's terminology wherever feasible. As this is an extremely stable genus, not all of the illustrations used have been selected from the species named.

I wish to express my appreciation to: Dr. Wm. K. Gregory, Curator of the Department of Ichthyology at The American Museum of Natural History, New York City, for the use of material from the Museum collections, and for research facilities at the Museum at all times; Dr. Naohide Yatsu and Dr. Negumi Eri who made available to me the necessary research facilities at the Imperial University of Tokyo and at the Marine Biological Laboratory at Misaki, Japan, and especially to Dr. Shigeo Tanaka for the valuable specimens supplied to me from his collections at the University; Dr. H. C. Delsman, and Dr. Verwey of the staff at the Laboratorium voor Het Onderzoek der Zee, Batavia, Java, in 1931, for material from the Laboratory collections, and for research facilities there.

For the convenience of the reader the characters of the suborders of the Order Galea, and of the superfamilies of the Suborder Carcharinida, are listed in parallel columns in Tables I and II. All of the species described here belong to the Suborder Carcharinida, and the transitional characters concerned connect the two superfamilies of that suborder, the Catuloidea and the Carcharinoidea. The terms catuloid and carcharinoid are used to refer to superfamily groups, and the terms catulid, triakid, and carcharinid, etc., to refer to family groups. The terminology is that used in my classification referred to above.

### INTRODUCTION

The external characters of the elasmobranchs, including the teeth which are structurally homologous with the denticles, and those skeletal parts which are superficial in position and directly related to the external characters, are in a position to be more easily influenced by changes in the environment, and by feeding and swimming habits than are the more deeply seated internal characters. The superficial characters may be termed physiologic, therefore, in contrast to the phylogenetic. The physiologic characters will vary within closely related groups, even within a single genus, and many times will show parallel variations in groups of widely separate origin. The phylogenetic characters, on the other hand, have tended to show little change since the Jurassic and Cretaceous periods. Their development has been slow, but in definite directions, and they may be depended upon to establish true phylogenetic relationships even when the modern environment has caused apparently erratic variation in the physiologic characters. Thus we frequently find species in which the skeletal structures show an ancient origin while the superficial characters show advanced specializations to specific environments. Conversely, species are found which have advanced in their skeletal structure while retaining, or returning to, a primitive type of environment and thus showing primitive surface characters.

The sharp demarcation which I have shown in my suborder groupings between the spotted orectoloboid sharks and the spotted catuloid sharks is based on a group of correlated phylogenetic characters shown specifically in the vertebral centra, in the rostral cartilages, the pectoral fin base, the heart valves and the spiral valves. These small sharks have frequently been grouped together on the basis of parallel physiologic resemblances, whereas the structural demarcation was established during the Jurassic and has led through two diverse tendencies in development toward two wholly different groups of pelagic sharks.

Examination of a large number of specimens within the Suborder Carcharinida showed that the phylogenetic characters have more stability than the physiologic. Thus, the type of triradial rostrum is invariable in the group, but the variation in the length and strength of the three rostral cartilages is correlated with the shape of the snout. There is no variation in the basic structure of the pectoral fin skeleton, in the arrangement of the radials on the basals, or, except in rare cases, in the number of segments in the radials, but the length of the radials varies with the shape of the fin. The diplospondylic vertebral structure is consistent within the entire group, but the secondary calcifications show so consistent a variation as to indicate an ancient origin. There is no variation in the basic structure of the skeletal support of the myxopterygia, in the number of stem elements or in the shape of the axial cartilages, but extreme and inconsistent variation occurs in the tendency for these cartilages to be rolled into a scroll, possibly indicating the recent development of these structures.

Thus it appears that the basic skeletal structures have been well established in the most primitive of these modern sharks, but that secondary skeletal structures have been later in establishing stability, and so give some hint as to the direction of development. This direction in the suborder under consideration appears to have been from a sluggish shore-dwelling type similar to the Jurassic catuloids toward a freer pelagic life as seen at its best in the swift and voracious carcharinids.

#### DISCUSSION

The seven species under discussion, *Catulus retifer*, *Catulus torazame*, *Halaelurus burgeri*, *Calliscyllium venustum*, *Atelomycterus marmoratus*, *Triakis scyllium*, and *Carcharinus milberti japonicus*, are shown in the order named in Fig. 1, and the structures referred to in this comparison are illustrated in the succeeding figures and listed in a comparative table (Table III). The first five species are catuloids and the last two are carcharinoids.

#### GENERAL FORM

In the catuloids the body is characteristically shorter than the tail with the first dorsal fin either over or back of the pelvis. This condition is typical of fishes which travel slowly and attack prey by swishing the body from side to side with the tail as a lever. The mouth gapes in such forms are narrow, the teeth small and pluricuspid, and a possible protective camouflage is provided by the spotted and striped skins.



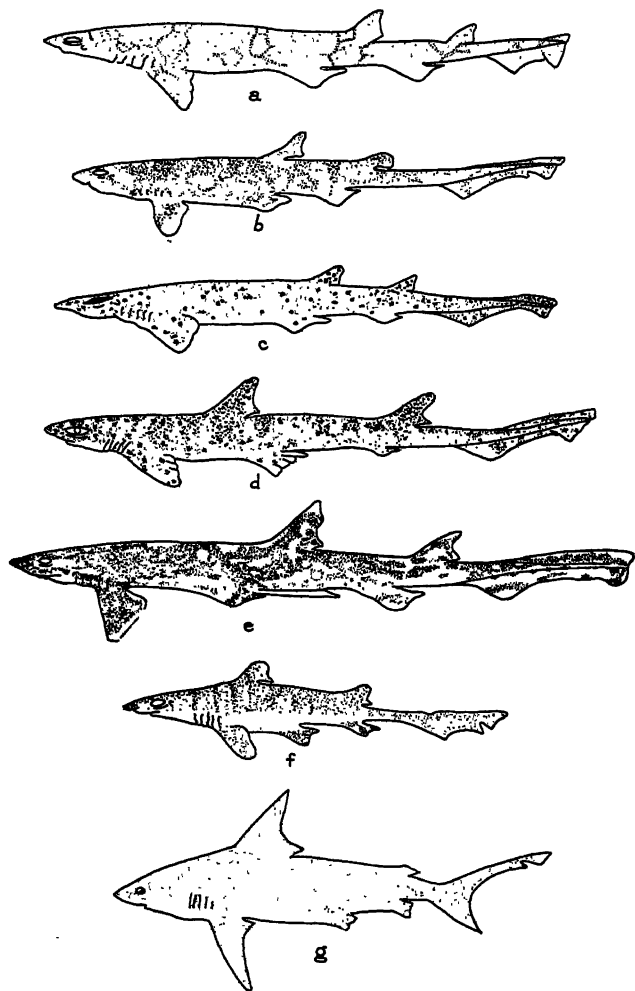
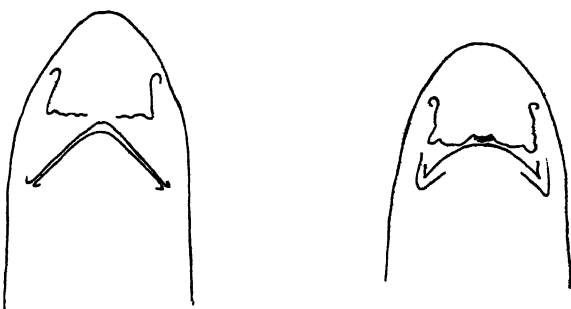
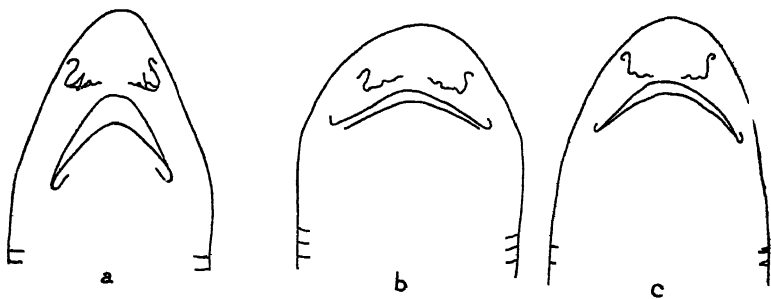


Fig. 1. a, *Catulus retifer*; b, *Catulus torazame*; c, *Halaelurus burgeri*; d, *Calliscyllium venustum*; e, *Atelomycterus marmoratus*; f, *Triakis scyllium*; g, *Carcharinus milberti japonicus*.



f

g

Fig. 2. Heads, ventral view: a, *Catulus retifer*; b, *Catulus torazame*; c, *Halaelurus burgeri*; d, *Calliscyllium venustum*; e, *Atelomyclerus marmoratus*; f, *Triakis scyllium*; g, *Carcharinus milberti japonicus*.

In the carcharinoids the body is deepened anteriorly and the first dorsal fin is far forward. This is characteristic of pelagic swimmers and gives greater strength and swiftness. The mouth gapes are wide and farther from the snout than in the catuloids, and the teeth tend to become large and unicuspid. Characteristically the coloration is uniform, darker above and lighter below.

*Triakis scyllium* represents a transitional carcharinoid, bridging the gape between the littoral catuloids and the pelagic carcharinoids. The forward position of the dorsal fin and the deepening of the anterior region are characteristic and although *Triakis* is a small shark it is a swift swimmer and is found in quite deep waters. The mouth gape is intermediate and labial folds are retained. The teeth are small, numerous and three-cusped and may be an intermediate stage in the development of the unicuspid tooth, and the mouth is quite far from the snout.

*Calliscyllium venustum* parallels *Triakis* in several surface features and was classed as a species of *Triakis* by Garman in 1913, due to the forward position of the first dorsal fin which has always been looked upon as a determining character in the classification of sharks. There is, however, no corresponding deepening of the anterior region, the shark being peculiarly eel-like, and while it is found in quite deep waters it is a slow swimmer and has retained the mouth gape, teeth, and feeding habits of the littoral forms. It represents, therefore, a transitional stage in the tendency toward deep-sea life.

*Atelomycterus* is also an elongate shark which has paralleled the carcharinoids in some respects. It has, however, retained the posterior dorsal and has an even more shallow mouth gape than the typical catuloids. The nasal valves have reached the mouth to form nasoral grooves, a pronounced adaptation toward the feeding habits of grovelers. The life of *Atelomycterus* is a peculiar mixture of shallow- and deep-water habits. The shark is found exclusively among the coral reefs, chiefly of the Malay Archipelago where its eel-like body is adapted to the sinuous movements in and about the sharply cornered reefs, and its mouth to feeding upon the small animal life which frequents the coral reefs. This is not a transitional shark but represents the adaptation of a type far advanced in its internal structure to a peculiarly restricted environment.

#### NICTITATING FOLD

The presence of a nictitating fold or membrane in this group is peculiar in that it appears in no other group of sharks and in that

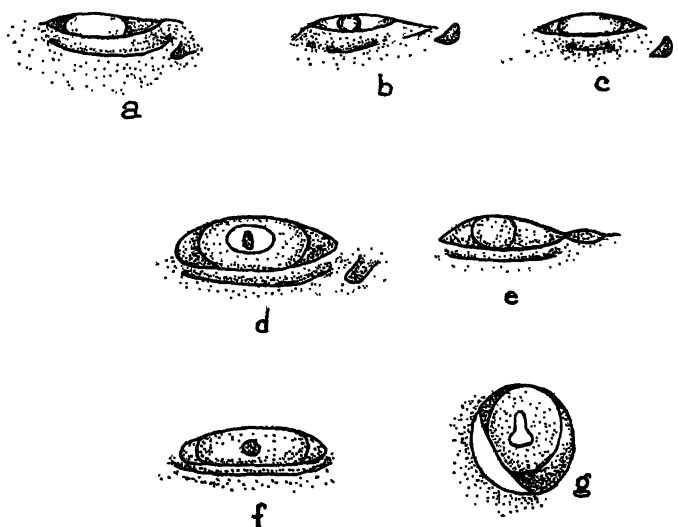


Fig. 3. Eye, spiracle and nictitating fold of: a, *Catulus retifer*; b, *Catulus torazame*; c, *Halaehurus burgeri*; d, *Calliscyllium venustum*; e, *Atelomycterus marmoratus*; f, *Triakis scyllium*; g, *Carcharinus milberti japonicus*.

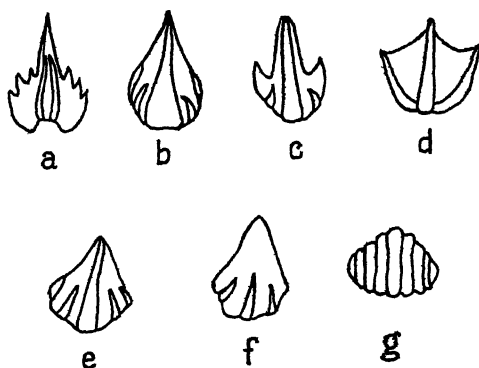


Fig. 4. Denticles from the dorsal surface of: a, *Catulus retifer*; b, *Catulus torazame*; c, *Halaehurus burgeri*; d, *Calliscyllium venustum*; e, *Atelomycterus marmoratus*; f, *Triakis scyllium*; g, *Carcharinus milberti japonicus*.

respect is correlated with the specific type of vertebral structure found in the suborder. This correlation between an internal skeletal structure and a surface structure is extraordinary and suggests the linkage of widely separate characters.

That the fold shows transition from a shallow fold to a complete third eyelid is shown in Fig. 3. This transition is not entirely correlated with the vertebral development, however, since *Triakis* and *Atelomycterus* retain the fold with the complete vertebral structure. It does show, nevertheless, that the more deeply seated skeletal structure reached its completion at an earlier time than the superficial one, and possibly indicates that the character is not one easily affected by changing environments.

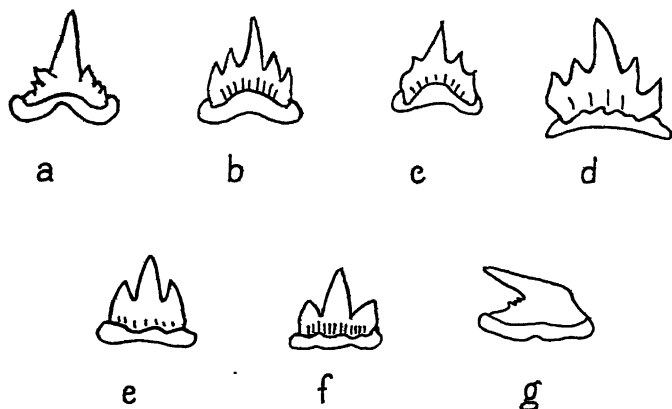


Fig. 5. Teeth, upper jaw of: *a*, *Catulus retifer*; *b*, *Catulus torazame*; *c*, *Halaelurus burgeri*; *d*, *Calliscyllium venustum*; *e*, *Atelomycterus marmoratus*; *f*, *Triakis scyllium*; *g*, *Carcharinus milberti japonicus*.

The length of the fold varies without any evident relation to the variations in the nasal valves. It appears to be shorter and less deep in the types adapted to the shallower waters, and to lengthen as the deeper waters are invaded, but this correlation is not absolute. The complete membrane is found only in the Carcharinidae where it sometimes functions as a third eyelid.

#### DENTICLES

The denticles (Fig. 4) show a tendency toward the flattened shell-like denticles of the pelagic forms in the smoothing out of the margin.

In the littoral forms the keels are sharp and incomplete, and the margin is decidedly lobed. In the more active swimmers the margin is decidedly less lobed and the keels are more complete.

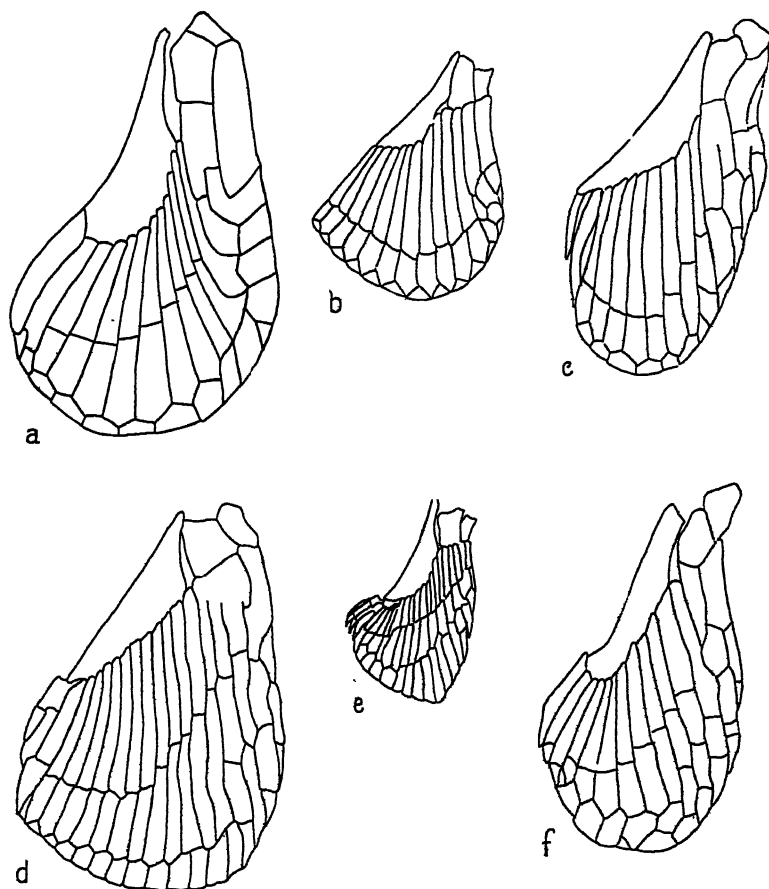


Fig. 6. Pectoral fin skeletons with propterygium on the right and expanded metapterygium on the left: *a*, *Catulus retifer*; *b*, *Catulus torazame*; *c*, *Halaehurus burgeri*; *d*, *Calliscyllium venustum*; *e*, *Atelomycterus marmoratus*; *f*, *Triakis scyllium*.

#### ROSTRUM

The triradiate rostrum is found consistently throughout the entire suborder and the only variation appears in the length and strength of the cartilages concerned. In the more pelagic forms these converge

into a point, but where the snout is depressed or broadened the front margin of the rostrum becomes squared. In no case does any break occur between the cartilages as in the orectolobid sharks.

#### PECTORAL FIN SKELETON

There is a consistent reduction of the propterygium throughout the suborder, but in all cases the radials are concentrated largely on the

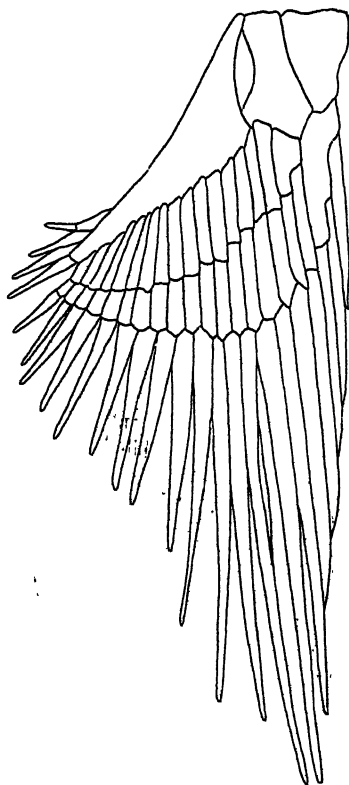


Fig. 7. Pectoral fin skeleton of *Carcharinus milberti japonicus*.

metapterygium. The radials are characteristically of three segments but in *Atelomycterus* some slight reduplication is apparent, correlating with the lengthened eel-like body. The length of the radials is determined by the length of the fin, and in *Carcharinus* the distal radials are greatly elongated to accommodate the long, falciform fins (Fig. 7). This is accomplished in the pelagic forms without reduplication.

## VERTEBRAL CENTRA

The secondary calcifications around the central double cone of the vertebral centra give the clearest picture of transition between the catuloids and carcharinoids (Fig. 8). The asterospondylic type is characteristic of the entire Order Galea, but in the Suborder Carcharinida the Maltese-cross type is so consistent as to provide a sharp line of de-

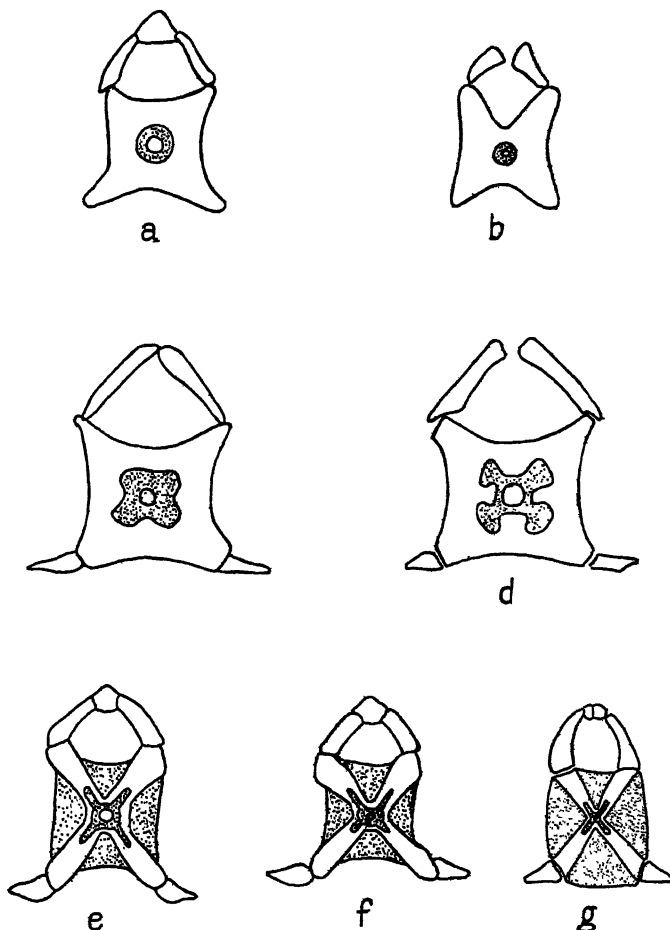


Fig. 8. Vertebral centra: *a*, *Catulus retifer* (Catulidae); *b*, *Catulus torazame* (Catulidae); *c*, *Halaehurus burgeri* (Halaehuridae); *d*, *Calliscyllium venustum* (Halaehuridae); *e*, *Atelomycterus marmoratus* (Atelomycteridae); *f*, *Triakis scyllium* (Triakidae); *g*, *Carcharinus sorrah* (Carcharinidae).



marcation between the two suborders. There are, however, certain primitive and transitional stages (Fig. 8 *a-d*) which I believe to have been retained from the Jurassic Period. This question is reviewed in the classification recently published (Amer. Mus. Novitates No. 837), where I have shown that the cases of asterospondylic vertebrae described in the literature on fossil forms are without doubt tectospondylic according to Tate Regan's modifications of Hasse's original definitions, and that what meager data exist concerning the vertebrae of the Jurassic catuloids show them to be of the cyclospondylic type. The Maltese-cross type was not established until the Cretaceous, when it was completed for all time.

Tate Regan believes the appearance of the cyclospondylic vertebrae in the modern catuloids indicates a retrogressive development returning to the primitive plan. The presence of cyclospondylic vertebrae, however, in the small Jurassic catuloids, *Pristiurus* and *Crossorhinus*, and the close resemblance of these fossil sharks to the modern genera preclude this possibility, and I believe the vertebral types in the modern catuloids to be a retention of a primitive phylogenetic character.

The transitional stages found in *Halaehurus* and in *Calliscyllium* are so pronounced as to indicate a definite tendency toward the formation of four calcified areas (Fig. 8 *c* and *d*), and the complete Maltese-cross type found in *Atelomyxerus* (Fig. 8 *e*) indicates the completion of the type before the pelagic life was attempted. These phylogenetic tendencies are overshadowed by the adaptation of these modern forms to environments of widely differing types.

Believing the phylogenetic tendencies to be of more significance than the physiologic, I have divided the catuloid sharks into three families based on the cyclospondylic, the transitional, and the complete type of vertebra. Owing to the incomplete descriptions in the literature it has been impossible to assign all species with accuracy, but where the vertebrae have been either examined directly or described in the literature it has been possible to reassign certain species whose descriptions in Garman tally closely with the known types. In the case of genera of unknown vertebral type Garman's classification has been followed, but it is to be hoped that investigators in this field will add to the data now available by examining the vertebrae of those genera of doubtful assignation.

#### SPIRAL VALVES

The spiral valves show a general tendency toward a reduction in the number of valves, culminating in the scroll type which is character-

istic of the pelagic carcharinoids. The retention of a reduced number of valves in *Triakis* is indicative of its transitional nature. The only case of duplication of valves appears in *Atelomycterus*, where the eel-like body probably accounts for the duplication. This is paralleled in the reduplication of radials in the pectoral fin. *Atelomycterus* is inconsistent in this respect, however, in that the reduplication is not carried out in the heart valves or in the cusps of the teeth. This inconsistency is found, also, in its mixture of feeding and swimming habits.

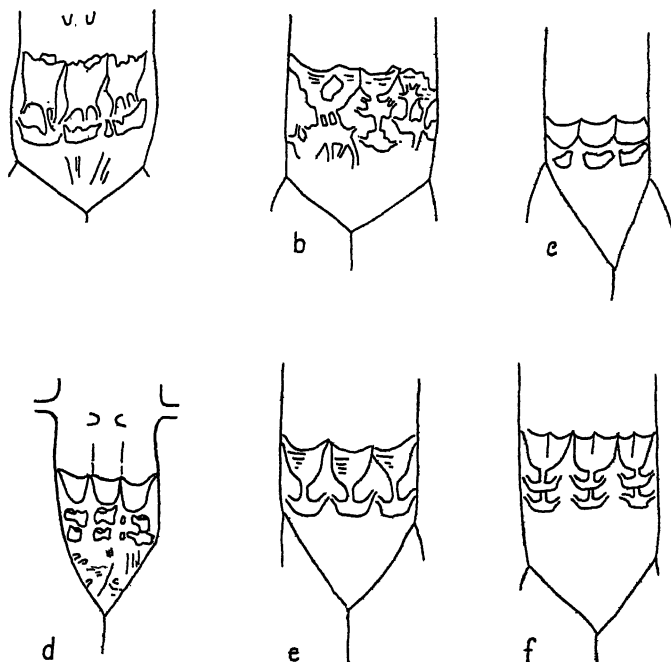


Fig. 9. Heart valves: a, *Catulus retifer*; b, *Catulus torazame*; c, *Halaelurus burgeri*; d, *Calliscyllium venustum*; e, *Atelomycterus marmoratus*; f, *Carcharinus sorrah*.

#### HEART VALVES

The heart valves of the elasmobranchs, as shown in my recent paper (Am. Mus. Novitates No. 838) show a general tendency toward multiplication and progress from the primitive two-row type to three and even more rows. In the Suborder Carcharinida the progress is from two rows in the catuloids to three rows in the carcharinoids (Fig. 9).

*Catulus torazame* has a heart in which the transition from two to three rows is seen in progress. The valves frequently multiply in one row and then move down to form an additional row. In *Calliscyllium* the three valves are complete, but *Atelomycterus* which parallels *Triakis* in so many ways has retained the primitive two rows.

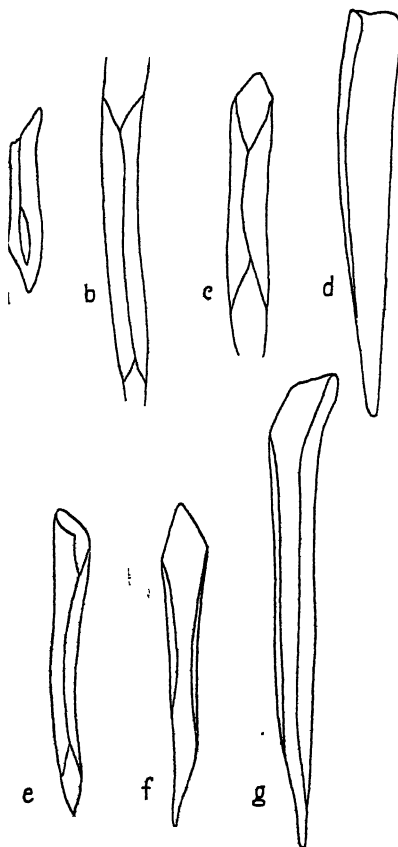


Fig. 10. Axial cartilages: a, *Catulus retifer*; b, *Catulus torazame*; c, *Halaelurus burgeri*; d, *Calliscyllium venustum*; e, *Atelomycterus marmoratus*; f, *Triakis scyllium*; g, *Carchartinus milberti japonicus*.

#### MYXOPTERYGIA

There is more variability shown in the axial cartilages of the myxopterygia than in any other vertebral structure. The basal elements and the general shape of the cartilages are entirely consistent through-

out the suborder, but the tendency to roll or unroll the marginal cartilages is strangely inconsistent. The earliest known sharks have no indication of any adaptation for internal fertilization, and it is probable that egg-laying with external fertilization preceded the condition characteristic of the modern sharks. It is possible, therefore, that the instability of the structural character of the axial cartilages is an indication of its comparatively late development.

In many of the catuloids the marginal cartilages are rolled into a tight scroll as in both species of *Catulus*, in *Halaehurus*, and in *Atelomyxterus*. In *Calliscyllium*, *Triakis*, and *Carcharinus milberti japonicus* the margins are only slightly rolled in from the edge. This condition is not stable even in *Carcharinus*, however, some species having the marginals rolled and others open.

#### SUMMARY

Variation in the catuloids is so extreme as to make distinction even between genera difficult, and a study of the phylogenetic characters is of the utmost importance, therefore, in establishing relationships. The group is extremely stable in its phylogenetic characters, varying only in secondary structures, so that any important variation occurring in these structures may be considered of phylogenetic value.

The important variations include:

- Length and shape of body (typically shorter than tail, occasionally eel-like);
- Position of first dorsal fin (typically over or posterior to pelvis, rarely anterior);
- Size and shape of all fins;
- Armature on caudal (rare and primitive condition);
- Size of eye and spiracle;
- Length of nictitating fold;
- Extent of labial folds;
- Nasal valves and cirri (occasional nasoral grooves);
- Dermal denticles;
- Teeth (typically small, numerous, and five-cusped);
- Heart valves (typically two rows, rarely three; phylogenetic);
- Spiral valves (typically five to ten rows, tendency to reduction and to reduplication, phylogenetic);
- Vertebral centra (cyclospondylic, intermediate, and rarely Maltese cross; phylogenetic);
- Marginal axial cartilages of myxopterygia (typically rolled, tending to open);
- Radials of pectoral fin skeleton (length, and rarely number of segments; phylogenetic).

The transitional species chosen are those which combine primitive catuloid characters with characters approaching or parallel to carcharin-

oid characters. The transitional characters are of more importance if concerned with the phylogenetic characters of which only the vertebral centra, heart valves and spiral valves vary to any considerable extent.

The characters of these species are listed below. The retained characters are those typical of the more primitive catuloids; the transitional characters are those which lead in the direction of the stable carcharinoid condition; the advanced characters those which parallel the carcharinoid condition, and the peculiar characters those which adapt the species to an environment not typical of either the catuloid or carcharinoid sharks.

*Catulus torazame*

Retained characters:

- Body short
- First dorsal posterior
- Nictitating fold rudimentary
- Denticles incompletely keeled
- Teeth five-cusped
- Vertebral centra cyclospondylic (phylogenetic)
- Marginal axial cartilages rolled into a scroll, loosely
- Oviparous

Transitional characters:

- Heart valves forming a third row (phylogenetic)

*Calliscyllium venustum*

Retained characters:

- Denticles incompletely keeled
- Teeth five-cusped
- Oviparous

Transitional characters:

- Nictitating fold intermediate
- Marginal axial cartilage open
- Vertebral centra intermediate (phylogenetic)

Advanced characters:

- First dorsal anterior
- Marginal axial cartilages open
- Third row of heart valves complete (phylogenetic)

Peculiar characters:

- Body lengthened but not deepened anteriorly

*Atelomycterus marmoratus*

Retained characters:

- First dorsal posterior
- Nictitating fold shorter than eye
- Denticles with incomplete keels
- Marginal axial cartilages coiled
- Oviparous

Transitional characters:

- Denticles not lobed

Teeth three-cusped

Advanced characters:

Vertebral centra of Maltese-cross type (phylogenetic)

Peculiar characters:

Body eel-like

Nasoral grooves

Slight reduplication of radials in pectoral fin skeleton (phylogenetic)

Reduplication in spiral valves

Within the carcharinoids, *Triakis scyllium* represents a transitional stage between the catuloid and the complete carcharinoid structure. This species has already been recognized by Leigh-Sharpe (1920) as transitional because of the presence of a retained clasper siphon and gland. My examination shows it to be transitional in many other respects also, and so decidedly leading to the stable condition of the carcharinoids that I have separated it from the specialized Galeorhinidae with which it has been associated in the literature and have made a new family, the Triakidae, to accommodate its transitional nature.

*Triakis scyllium*

Transitional characters:

Body spotted and striped

Spiracles small

Teeth three-cusped

Labial folds retained

Nictitating fold as long as eye

Denticles with incomplete keels

Spiral valves with few spirals (phylogenetic)

Advanced characters:

Body deepened anteriorly

First dorsal anterior

Vertebral centra of Maltese-cross type (phylogenetic)

Heart valves in three rows (phylogenetic)

Marginal axial cartilages open

Ovoviviparous

*Carcharinus*

Variable characters:

Spiracle minute or absent

Teeth serrated or smooth

Marginal axial cartilages coiled or open

Stable characters:

Color uniform, darker above

Body deepened anteriorly

First dorsal anterior

Nictitating membrane complete

Labial folds absent

Denticles completely keeled, shell-like

Vertebral centra of Maltese-cross type (phylogenetic)

Heart valves in three rows (phylogenetic)

Spiral valves of scroll type (phylogenetic)

Ovoviviparous

*Carcharinus milberti* (subspecies *japonicus*)

Spiracle absent

Teeth serrate, triangular on both jaws, lower teeth erect

Marginal axial cartilages open

In basing family divisions on phylogenetic characters several new families have been established, and new definitions compiled. These are listed below.

### Catulidae

Catulidae of Garman, in part; Galeidae of Tanaka, in part; Scyliorhinidae of Regan, in part.

DEFINITION.—Body shorter than tail; anterior dorsal posterior to or just over pelvics; eyes large, lateral, nictitating fold shorter than eye; spiracles prominent; teeth small, pluricuspid, in several series; nasal valves nearer mouth than snout, occasionally reaching the mouth; denticles with prominent central keels, and lateral keels incomplete; vertebral centra cyclospöndylic; heart valves in two rows; spiral valves with from five to ten valves.

#### CATULUS VALMONT, 1768

*C. retifer* Garman, 1913 (*Scyllium retiferum* Garman, 1881, *Scyliorhinus retifer* Jordan and Gilbert, 1883, Jordan and Everman, 1896; Goode and Bean, 1896; *Scyliorhinus retifer* Regan, 1908).

HABITAT.—Atlantic coast.

SPECIMEN.—Young male from the collection of The American Museum of Natural History, New York.

*C. torazame* Tanaka, March 15, 1908 (*Scyliorhinus rudis* Pietschman, March 19, 1908; *Halaelurus rudis* Tanaka, 1911, *H. torazame* Tanaka, 1912).

HABITAT.—Sagami Sea, Japan. Locally known as Torazame, tiger shark.

SPECIMENS.—Adult male and female (female with mature egg cases in oviduct) presented by Dr. Shigeo Tanaka from the collection of the Imperial University at Tokyo, Japan, 1930.

### Halaeluridae, new family

Catulidae of Garman, in part; Galeidae of Tanaka, in part; Scyliorhinidae of Regan, in part.

DEFINITION.—Body shorter than tail; anterior dorsal over or anterior to pelvics; eyes medium, lateral, nictitating fold shorter than eye; spiracles prominent; teeth small, pluricuspid, in several series; nasal valves closer to mouth than snout, rarely reaching mouth; denticles

with prominent central keels, lateral keels incomplete; vertebral centra of intermediate types; heart valves in two to three rows; spiral valves in five to ten rows.

**HALAELURUS** GILL, 1861

*Scyllium* Müller and Henle, 1841.

*H. burgeri* Gill, 1861, Garman, 1913; *Scyllium burgeri* Müller and Henle, 1841; Schlegel, 1850; Bleeker, 1856; Duméril, 1865; Günther, 1870.

HABITAT.—Coastal waters from Japan to East Indies.

SPECIMENS.—Adult male and female presented by Dr. Shigeho Tanaka from the collection of the Imperial University of Tokyo in 1930.

**CALLISCYLLIUM** TANAKA, 1912 (in Family Galeidae)

*Triakis* Garman, 1913 (in Family Galeorhinidae).

*C. venustum* Tanaka, 1912; *Triakis venusta*, Garman, 1913.

HABITAT.—Sagami Sea, Japan. Locally known as H̄yozame, leopard shark.

SPECIMENS.—Adult male and female presented by Dr. Shigeho Tanaka from the collection of the Imperial University in Tokyo, 1930.

**Atelomycteridae**, new family

Catulidae of Garman, in part; Scyliorhinidae of Tate Regan, in part.

DEFINITION.—Body elongate; anterior dorsal posterior to pelvis; eyes large, lateral; spiracles prominent; nictitating fold as long as eye; teeth three-cusped; denticles with prominent central keels, lateral keels incomplete; vertebral centra of complete Maltese-cross type; heart valves in two rows; spiral valves numerous; radials of pectoral fin slightly reduplicated.

**ATELOMYCTERUS** GARMAN, 1913

*Scyllium* Bennett, 1830; *Scyliorhinus* Regan, 1908.

*Scyllium marmoratum* Bennett, 1830; *Scyllium maculatum* Gray and Hardwicke, 1832; Müller and Henle, 1841; Richardson, 1846; T. Cantor, 1849; Bleeker, 1852; Duméril, 1865; Günther, 1876; *Scyliorhinus marmoratus* Regan, 1908; *Atelomycterus marmoratus* Garman, 1913.

HABITAT.—Coral reefs of Malay Archipelago.

SPECIMEN.—Adult male presented by Dr. Verwey from the collection of the Laboratorium voor Het Onderzoek der Zee, Batavia, Java in 1931.

**Triakidae**, new family

Galeorhinidae of Garman, in part; Carcharidae of Regan, in part.

DEFINITION.—Body longer than tail, deepened anteriorly; first dorsal anterior to pelvis; eyes large, lateral; spiracles small; nictitating fold as long as eye; teeth small, numerous, three-cusped; denticles without prominent central keel, lateral keels incomplete; vertebral



centra of complete Maltese-cross type; heart valves in three rows; spiral valves few in number.

TRIAKIS MÜLLER AND HENLE, 1838

*T. scyllium* Müller and Henle, 1841; Duméril 1865; Günther, 1870; Ishikawa and Matsura, 1897; Snyder, 1900, Jordan and Fowler, 1903; Pietschman, 1908; Garman, 1913.

HABITAT.—Coastal waters of Japan.

SPECIMENS.—Male and female adults and young from open markets in Tokyo, Japan.

Carcharinidae Garman

Carcharidae Regan.

DEFINITION.—Body fusiform, deepened anteriorly; first dorsal anterior to pelvics; eyes small with more or less complete nictitating membrane; spiracles minute or absent; teeth large, few, with a single triangular cusp, with or without lateral serrations; denticles completely keeled, shell-like, without prominent central keel; vertebrae of complete Maltese-cross type; heart valves in three rows; spiral valves of scroll type.

CARCHARINUS BLAINVILLE, 1816

*Carcharias* Cuvier, 1817.

HABITAT.—Open oceans, universal.

*Carcharinus milberti* Jordan and Gilbert, 1883; *Carcharias Prionodon milberti* Müller and Henle, 1841. Subspecies *C. japonicus* Schlegel, 1850.

*Specimen*.—Fresh adult male, Misaki market, Japan.

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TABLE I.—SUBORDERS OF THE ORDER GALEA

ISURIDA	CARCHARIDA
Nictitating membrane absent	Nictitating fold or membrane present
Vertebral centra asterospondylic with secondary calcifications radiating, often branching in the calcified areas	Vertebral centra asterospondylic with secondary calcifications forming a Maltese cross or rudimentary
No rod-like calcifications in the uncalcified areas	Four rod-like calcifications in the uncalcified areas in Maltese-cross type
Spiral valves of ring type	Spiral valves of spiral or scroll type
Rostral cartilages triradiate open or closed	Rostral cartilages triradiate invariably closed
Pectoral fin skeleton	Pectoral fin skeleton
Radials on mesopterygium and metapterygium primitively equal	Radials mostly on metapterygium
Segments of radials typically more than three	Segments of radials three (rarely more)

TABLE II.—SUPERFAMILIES OF THE CARCHARINIDA

CATULOIDEA	CARCHARINOIDEA
Dorsals:	Subequal
First dorsal:	Posterior to pelvics (rarely anterior)
Nictitating membrane:	Fold present
Spiracle:	Prominent
Nasoral grooves:	Absent or present
Labial folds:	Present
Denticles:	Central keel prominent
	Keels incomplete
Teeth:	Small, pluricuspid
Series:	Several
Heart valves:	2 (rarely 3)
Spiral valves:	5-10 (rarely more)
Pectoral fin skeleton:	
Radials	Mostly on metapterygium
Segments	3 (rarely more)
Rostral cartilages:	3 united
Vertebral centra:	Cyclospondylic, intermediate or rarely type
Claspers:	
Siphon	Large
Gland	Absent
Groove	Closed
Marginal axial cartilages:	Rolled (rarely open)
Reproduction:	Oviparous

TABLE III

	<i>Catulus retifer</i>	<i>Catulus torosus</i>	<i>Halaelurus burgeri</i>	<i>Calliscyllium venustum</i>	<i>Atelomycterus marmoratus</i>	<i>Triakis scyllium</i>	<i>Carcharinus milberti</i>
Body:	Short	Short	Short	Elongate	Elongate	Deepened anteriorly	Deepened anteriorly
Spots and stripes:	Present	Present	Present	Present	Present	Faint	Absent
Nictitating fold:	Slightly shorter than eye	Much shorter than eye	Much shorter than eye	Slightly shorter than eye	Shorter than eye	Equal length	Nictitating membrane complete
Spiracle:	Large	Large	Large	Large	Large	Small	Absent
Labial folds:	Present	Present	Present	Present	Present	Present	Absent
Nasoral grooves:	Present or absent	Absent	Absent	Absent	Present	Absent	Absent
Denticles:							
Apical margin	Lobed	Not lobed	Lobed	Lobed	Not lobed	Not lobed	Not lobed
Central keel	Prominent	Prominent	Prominent	Prominent	Prominent	Not prominent	Not prominent
Lateral keels	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete	Complete
Teeth:	3-5-cusped	5-cusped	5-cusped	5-cusped	3-cusped	3-cusped	1-cusped
Heart valves:							
Number of rows	2	3, transitional	2	3	2	3	3
Spiral valves:	5-10	5-10	5-10	5-10	11-30	2-4	Scroll type
Vertebral centra:	Cyclospondylic	Cyclospondylic	Intermediate	Intermediate	Maltese cross	Maltese cross	Maltese cross
Myxopterygia:							
Marginal axial cartilages	Rolled	Rolled	Rolled	Open	Rolled	Open	Open





# AMERICAN MUSEUM NOVITATES

Number 880

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

October 8, 1936

## NOTES ON THE STRUCTURE, DISTRIBUTION, AND SYNONYMY OF *DIPHYLLOBOTHRIUM LANCEOLATUM*

By H. W. STUNKARD AND H. W. SCHOENBORN<sup>1</sup>

### INTRODUCTION AND METHODS

This investigation was made on some 30 specimens of *Diphyllbothrium lanceolatum* (Krabbe, 1865) which were submitted to us by The American Museum of Natural History for identification (A.M.N.H. Cat. Nos. 180 to 191). The material was collected in 1933 from the intestine of the bearded seal, *Phoca barbata*, in the region of the St. Lawrence Island, off the Alaskan coast.

This species was first described, although very briefly, by Krabbe (1865), from the intestine of *Phoca barbata* collected at Godhavn, near Greenland. Zschokke (1903) gave a detailed description of specimens from the same host, collected at Svalbard, in the Arctic Ocean, which he assigned to the species described by Krabbe. Evidently unaware of Zschokke's description, Cholodkovsky (1914) reported cestodes of *P. barbata* from the Kara Sea which agreed with Krabbe's description and which he referred to *D. lanceolatum*. His description, however, is very superficial. Cooper (1921) recorded this species from Bernard Harbour and from Dolphin and Union Strait, in the Northwest Territories, and noted certain differences between the specimens examined by him and Zschokke's description.

Meggitt (1924a and b) gave a list of the described species of the genus *Diphyllbothrium*. Included in each list are 23 species which have been found in seals. In one list (1924a) he omitted *D. polycalceolum* (which he referred to the genus *Bothriocephalus*) and included *D. antarcticum*. In the other list (1924b) he omitted *D. antarcticum* but included *D. polycalceolum*. If both these species belong to the genus *Diphyllbothrium*, it contained, according to Meggitt, 24 species recorded from seals. But since *D. coniceps* and *D. schistochilos* are identical with *D. lanceolatum* (see Discussion), the total number of species is reduced to 22.

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## DESCRIPTION

The majority of the worms submitted to us were immature and fragmented, and consequently of little value, since specific identification of immature cestodes is impossible. Fixation of the material was so poor that the tissues were unsatisfactory for histological examination. Attempts to refix the worms were ineffectual and it appears that the specimens had undergone partial decomposition before the original fixation.

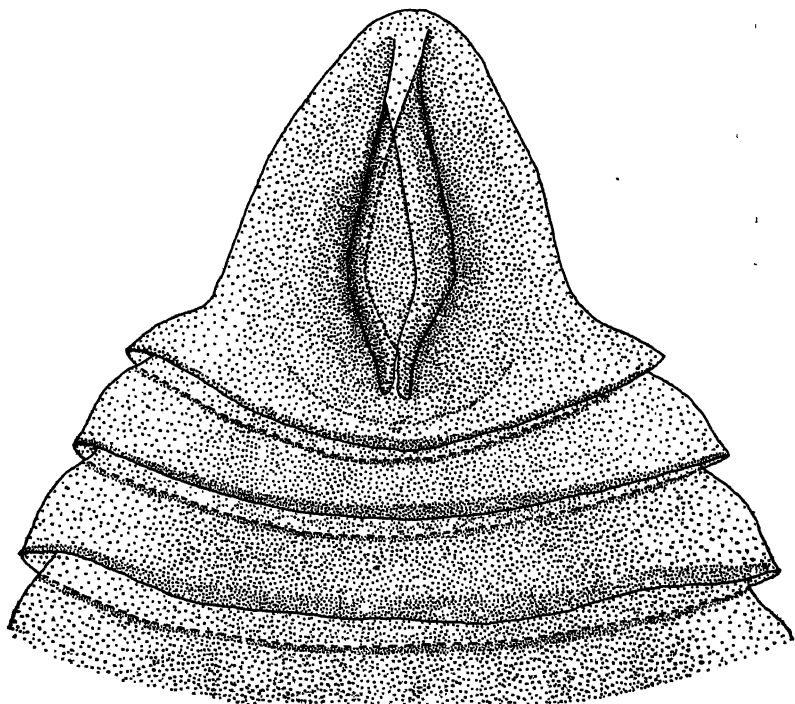


Fig. 1. Dorsal view of scolex and first two proglottids.  $\times 63$ .

From external examination, there are a few differences between the specimens at our disposal and previous descriptions. Our examples measure 20–28 mm. in length and 3.5–4.0 mm. in width as compared to Zschokke's measurements of 25–45 mm. by 3.0–4.5 mm. Cooper (1921) recorded specimens 50–68 mm. in length and 2.9–4.0 mm. in width, and

Cholodkovsky (1914) found a length of 15–40 mm. with a maximum width of 6 mm.

Another difference is in the size and appearance of the scolex. Zschokke gave 1.3–2.4 mm. in length and 0.8–1.5 mm. in width as measurements of the scolex; the corresponding measurements in our examples are 0.8–1.1 mm. and 0.7–1.4 mm. It is noted that while the width is almost the same in the two cases, the minimal length given by Zschokke is greater than the maximum observed by us. Zschokke's description and figures show that the bothria extend the entire length of the scolex. In our specimens they do not extend the whole length of the scolex, but begin about  $40\mu$  from the anterior end and terminate within  $68\mu$  of the posterior border. Furthermore, in the examples studied by us, the posterior portion of the scolex forms a projecting edge which somewhat overlies the first proglottid (Fig. 1), but such a condition is not shown in Zschokke's figures. Although Cholodkovsky did not describe the posterior limit of the scolex, his figures show a condition identical with that present in our specimens; he gave 0.5 mm. as the length of the scoleces in his examples. It is difficult to determine whether these differences can be ascribed to degrees of contraction of the scoleces; however, this explanation seems probable. Greater contraction of the scoleces reported by Zschokke would make them shorter and might also give them the appearance of those observed in our specimens. Still further contraction of the scoleces of our examples would make them shorter and wider, and comparable to that figured by Cholodkovsky.

The total number of proglottids in our examples, which varies from 61 to 99, agrees very well with that found by Zschokke since he found 60–96 segments in his specimens. Other workers have failed to record the number of proglottids.

Zschokke gave 0.4–0.7 mm. as the width of proglottids behind the scolex, 3.0–4.5 mm. as the width of proglottids in the middle of the worm, and 1.2–2.0 mm. as the width of those at the posterior end. He stated that the length of segments remains unchanged over long distances of the strobila and that it is only at the posterior end that the proglottids become somewhat longer; in this region they are almost square. However, Zschokke gave no measurements of length of proglottids. In our specimens the length of the posterior segments is only slightly greater than the length of the more anterior ones; also the posterior segments, and especially the terminal one, are more or less square even though their dimensions of length and width are less than the corresponding dimensions given by Zschokke. The size of proglottids of our specimens are as



follows: anterior segments, 0.20–0.28 mm. long and 1.5–2.0 mm. wide; middle segments, 0.31–0.40 mm. long and 3.5–4.0 mm. wide; posterior segments, 0.28–0.45 mm. long by 0.28–0.59 mm. wide.

Although for the most part similar, there are several differences in internal anatomy to be noted between Zschokke's description and the specimens examined by us. The chief differences are in the reproductive systems. Zschokke described the testicular follicles as disposed in 9–13 rows transversely, left and right, from the lateral edge of the proglottid to the uterus, and 10–12 rows from the anterior border to the posterior border of the proglottid. He found them arranged in a single or double layer in the medullary portion—usually there was a double layer near the uterus. In our specimens there are 17–21 rows transversely, left and right, from the lateral edge of the proglottid to the uterus, and 5–7 rows from the anterior to the posterior border of the proglottid. Also, in our specimens, the testes, which measure about  $55\mu$  in diameter, are never arranged in a double layer, but they always occupy a single layer in the center of the medullary portion. Fuhrmann (1931) stated: "Es ist klar, dass die Form der Glieder einen bedeutenden Einfluss auf die Anordnung der verschiedenen Geschlechtsorgane hat, indem bei kurzen Gliedern dieselben übereinandergelagert sind, während bei langen Gliedern eine Hintereinanderlagerung erfolgt, und zwar so, dass entweder die weiblichen, seltener die männlichen Geschlechtsdrüsen nach hinten verschoben werden." Evidently the disposition of the testicular follicles is subject to considerable variation due to the contraction of the various sets of muscles within the proglottid.

Zschokke described the cirrus as being long and round; and he stated that the cirrus sac has a very large circumference, is roundish or oval in shape, and takes up the entire thickness of the medullary layer; however, he gave no measurements. In our specimens the cirrus sac has a diameter of about  $160\mu$ , lies in the anterior part of the segment, partly in the medullary layer and partly in the cortical layer of the ventral side; usually it does not occupy the entire thickness of the medullary portion, but leaves the dorsal third or more free. The seminal vesicle, as described by Zschokke, is attached dorsally to the cirrus sac; in our examples it measures about  $55\mu$  in diameter. The cirrus, which is often protruded, has a length of about  $150\mu$  and a width of  $75\mu$ .

With respect to the ovary, Zschokke stated: "Das Ovarium charakterisiert sich durch seine seitlich weit ausgezogenen, ausgiebig und locker in Röhren verästelten Flügel." The ovary in our specimens has lateral lobes composed of loosely arranged cells, but there are no finger-like

projections such as are noted and figured by Zschokke. It measures about  $575\mu$  from side to side and  $200\mu$  in greatest length; however, the ovary varies to some extent in size and shape in different segments of the same strobila.

According to Zschokke, the uterus has 5-7 lateral loops of which the anterior one on each side surrounds the cirrus sac while the remaining loops slant obliquely toward the posterior border of the proglottid. Cooper (1921) stated that the most anterior loops of the uterus, in his examples, did not extend on both sides of the cirrus sac, but rather that they were found behind the middle of it. In our specimens there are

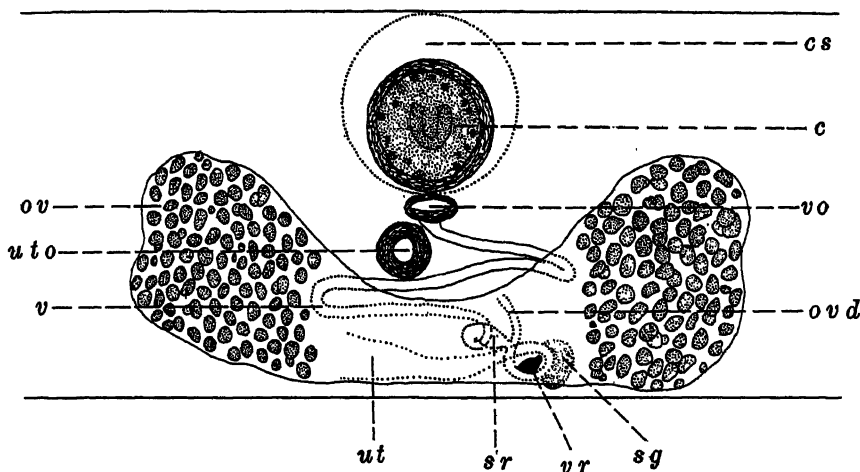


Fig. 2. Ventral view of central region of proglottid. Cells in the middle of the ovary are omitted in order to show the underlying oötype region. Semi-diagrammatic,  $\times 300$ .

c, cirrus; cs, outline of cirrus sac; ov, ovary; ovd, oviduct; sg, shell gland; sr, seminal receptacle; ut, uterus; uto, uterine pore; v, vagina; vo, vaginal pore; vr, vitelline receptacle.

only 3-5 uterine loops on each side, and while the anterior loops surround the cirrus sac, the remaining loops do not always slant obliquely toward the posterior border of the segment. It is possible that the differences which have been observed may be explained by differences in degree of congestion in the uterus and differences in muscular contraction of the proglottid. In case the foremost loops of the uterus contained very few eggs, they might lie behind the cirrus sac as observed by Cooper. On becoming more distended, they would be extended laterally and possibly anteriorly to surround the cirrus sac as observed by Zschokke and by us.

Although the oötype region observed in our examples corresponds with that figured by Zschokke, one difference may be noted: namely, that Zschokke neither mentions nor figures a shell gland nor a vitelline receptacle while these structures were observed in almost every proglottid studied by us. After the opening of the seminal receptacle into the oviduct, the latter proceeds posteriorly and forms a loop dorsally and to the right. The shell gland lies posterior and lateral to the dorsal part of this loop, and the vitelline receptacle is attached anteriorly and dorsally to this same region. The latter structure, about  $20\mu$  in length, is distinguished by its deeply staining reaction with haematoxylin while the former structure, which measures about  $55\mu$  in diameter, is characterized by its refractory or "brilliant" appearance (Fig. 2).

Considerable variation has been recorded concerning the size of eggs. Some of the measurements which have been given are as follows:

INVESTIGATOR	LENGTH	WIDTH
Krabbe (1865)	0.055-0.060 mm.	
Zschokke (1903)	0.062 mm.	$\times 0.040$ mm.
Cholodkovsky (1914)	0.056 mm.	$\times 0.020$ mm.
Cooper (1921)	0.064-0.068 mm.	$\times 0.040$ mm.

In our specimens the length varies from 0.055 to 0.069 mm. and the width from 0.032 to 0.042 mm.; the size of the majority of eggs is 0.061 mm.  $\times$  0.040 mm.

Krabbe found ripe eggs in the 13th and 14th proglottids, Zschokke in the 30th, Cooper in the 45th to 60th, while in our specimens ripe eggs were first seen in the 15th to 29th segments.

With respect to the nervous system, excretory system, musculature, and calcareous bodies described by Zschokke, our material shows no differences or does not permit comparison.

#### DISCUSSION

Even though there are certain minor differences between the examples described by Zschokke and those examined by us, these differences are not considered of sufficient importance to justify specific distinction, especially since the two groups of specimens agree so closely in the majority of anatomical features. Therefore these cestodes are assigned to the species *Diphyllbothrium lanceolatum* (Krabbe, 1865). The observations here recorded suggest the amount of variation which occurs in the structure of the species.

Germanos (1895) described *D. schistochilos* as a new species from the

intestine of *Phoca barbata*. Von Linstow (1905) described another new species, *D. coniceps*, from the intestine of the same host. The major differences between these descriptions and the structure of *D. lanceolatum* is in the size and shape of the scolex, and in the size of the proglottids. However, these differences may be due to differences in the degree of contraction of the specimens studied; hence, *D. schistochilos* (Germanos, 1895) and *D. coniceps* (Linstow, 1905) are here considered synonymous with *D. lanceolatum* (Krabbe, 1865).

The following is a list of species of the genus *Diphyllobothrium* found in seals.<sup>1</sup> Several of these species are inadequately described and further study may show them to be invalid.

SPECIES	Host
<i>D. antarcticum</i> (Baird, 1853) ( <i>Bothriocephalus</i> , <i>Dibothriocephalus</i> , and <i>Diplogonoporus antarcticus</i> )	<i>Ommatophoca rossi</i> , <i>Phoca</i> sp.
<i>D. archeri</i> (Leiper and Atkinson, 1914) ( <i>Dibothriocephalus archeri</i> )	<i>Ogmorhinus weddelli</i>
<i>D. clavatum</i> Railliet and Henry, 1912	" "
<i>D. coatsi</i> (Rennie and Reid, 1912) ( <i>Dibothriocephalus coatsi</i> )	" "
<i>D. cordatum</i> (Leuckart, 1863) ( <i>Bothriocephalus</i> , <i>Dibothriocephalus</i> , and <i>Dibothrium cordatum</i> )	<i>Phoca barbata</i> , <i>P. groenlandica</i> , <i>Trichechus rosmarus</i>
<i>D. elegans</i> (Krabbe, 1865) ( <i>Bothriocephalus</i> and <i>Dibothriocephalus elegans</i> )	<i>Cystophora cristata</i> , <i>Phoca vitulina</i> <i>Eumetopias jabata</i>
<i>D. hians</i> (Diesing, 1850) ( <i>Bothriocephalus phocae foetidae</i> Creplin 1825, <i>B. hians</i> , <i>Dibothriocephalus</i> and <i>Dibothrium hians</i> )	<i>Monachus albiventer</i> , <i>Phoca barbata</i> , <i>P. hispida</i> , <i>P. vitulina</i>
<i>D. lanceolatum</i> (Krabbe, 1865) ( <i>Bothriocephalus</i> and <i>Dibothriocephalus lanceolatus</i> , <i>Diphyllobothrium schistochilos</i> , and <i>D. coniceps</i> )	<i>Phoca barbata</i>
<i>D. lashleyi</i> (Leiper and Atkinson, 1914) ( <i>Dibothriocephalus lashleyi</i> )	<i>Ogmorhinus weddelli</i>
<i>D. latum</i> (Linnaeus, 1735) (Synonymy of this species appears in Stiles and Hassall's Index Catalogue of Medical and Veterinary Zoology)	<i>Cystophora cristata</i> , <i>Monachus albiventer</i> , <i>Phoca barbata</i> , <i>P. hispida</i> , <i>P. vitulina</i> , <i>Trichechus rosmarus</i>
<i>D. macrophallum</i> (Linstow, 1905) ( <i>Bothriocephalus macrophallus</i> )	<i>Phoca barbata</i> , <i>Arctocephalus ursinus</i>

<sup>1</sup> This list, with the exception of *D. polycalceolum* and the synonymy of *D. lanceolatum*, is taken from Meggitt (1924a). In this paper Meggitt considered *D. polycalceolum* as being in the genus *Bothriocephalus*.

SPECIES	HOST
<i>D. mobilis</i> (Rennie and Reid, 1912) ( <i>Dibothriocephalus mobilis</i> )	<i>Ogmorhinus weddelli</i>
<i>D. perfoliatum</i> Railliet and Henry, 1912	" "
<i>D. polycalceolum</i> (Ariola, 1896) ( <i>Bothriocephalus</i> and <i>Dibothriocephalus poly-</i> <i>calceolus</i> )	<i>Phoca vitulina</i>
<i>D. quadratum</i> (Linstow, 1891) ( <i>Bothriocephalus</i> and <i>Dibothriocephalus qua-</i> <i>dratus</i> )	<i>Ogmorhinus leptonyx</i>
<i>D. resimum</i> Railliet and Henry, 1912	? <i>Hydrurga leptonyx</i>
<i>D. rufum</i> Leiper and Atkinson, 1914	<i>Ogmorhinus weddelli</i>
<i>D. römeri</i> (Zschokke, 1903) ( <i>Dibothriocephalus römeri</i> )	<i>Trichechus rosmarus</i>
<i>D. scoticum</i> (Rennie and Reid, 1912) ( <i>Dibothriocephalus scoticus</i> )	<i>Ogmorhinus leptonyx</i>
<i>D. scotti</i> (Shiple, 1907) ( <i>Dibothriocephalus scotti</i> )	<i>Ommatophoca rossi</i>
<i>D. tectum</i> (Linstow, 1892) ( <i>Bothriocephalus</i> and <i>Dibothriocephalus tec-</i> <i>tus</i> )	<i>Macrorhinus leoninus</i>
<i>D. wilsoni</i> (Shiple, 1907) ( <i>Dibothriocephalus wilsoni</i> )	<i>Ogmorhinus weddelli</i> , <i>Ommatophoca</i> <i>rossi</i>

## SUMMARY

1.—Additions are made to Zschokke's (1903) account of the structure of *Diphyllobothrium lanceolatum* (Krabbe, 1865), and some of the variations which have been observed in this species are recorded.

2.—*D. schistochilos* (Germanos, 1895) and *D. coniceps* (Linstow, 1905) are considered synonyms of *D. lanceolatum*.

3.—A check list of the diphylobothrid species occurring in seals is given.

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# AMERICAN MUSEUM OF NATURAL HISTORY NOVITATES

Number 881

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

October 8, 1936

## NEW SPIDERS FROM TEXAS

By W. J. GERTSCH AND L. IRBY DAVIS

The types of the new species of spiders described below, all of which were collected in southern Texas by L. Irby Davis, are deposited in the collection of The American Museum of Natural History. Of particular interest is the addition of two more species of the genus *Zorocrates* and a second species of *Chorizomma* to the Nearctic fauna.

### Micryphantidae

#### *Erigone personata*, new species

Figures 1 and 2

MALE.—Total length, 1.90 mm. Carapace, 0.80 mm. long, 0.60 mm. wide.

Carapace dark reddish brown, the pars thoracica with numerous radiating dark streaks, the midline with a triangular dark maculation from which dark streaks go to the eyes and to the sides of the head. Eyes very narrowly ringed with black and enclosing a dusky field. Chelicerae reddish brown. Sternum black, the endites dull reddish brown, the coxae yellowish brown, with a black terminal ring and a narrow ventral black stripe. Legs pale yellow, clothed with rows of black hairs. Abdomen gray to black, clothed with short, inconspicuous hairs, with a few paler markings above.

Carapace longer than broad, the pars thoracica moderately convex, oval in outline, the pars cephalica strongly elevated, highest at the ocular area, nearly round as viewed from above, the clypeus protruding, rounded on the anterior margin, equal in height to the length of the median ocular quadrangle. Eyes of the first row slightly procurved, the medians separated by two-thirds the diameter, nearer the larger lateral eyes. Second eye row slightly procurved, the medians separated by scarcely the short diameter, as far from the subequal laterals. Median ocular quadrangle as long as broad, as wide in front as behind, the anterior medians slightly smaller. Lateral eyes of each side subcontiguous and subequal. Chelicerae armed on the outer side of the anterior face with five strong teeth and with two teeth near the inner margin. Upper margin of the furrow of the chelicera with four large teeth, the lower with three small ones. Sternum as long as broad, the posterior coxae separated by their width. Legs without spines. First femur with three strong ventral teeth on the retrolateral side and with two rows of setigerous bristles. Second femur with two ventral rows of setigerous bristles, of bases of two of them enlarged to form tubercles. Tibia and patella of the first leg, 0.70 mm. long. Femur of the palpus four and one-half times as long as broad, slightly curved, with a row of seven setigerous bristles. Patella half as long as the femur, with a short ventral spur at the distal end as figured. Tibia with apophyses a little longer than the patella, greatly enlarged distally. Details of the tarsus and bulb as figured.



TYPE LOCALITY.—Male holotype from Llano, Llano County, Texas, December 24, 1935 (L. I. Davis).

This species is related to *Erigone canthognatha* Chamberlin and Ivie in the general details of the palpus and in the spinal formula of the legs. It is distinct in the smaller size and in the proportionately shorter joints of the palpus, the patella being equal to only half the length of the tibia and tarsus, whereas in *canthognatha* it is subequal in length to these two joints. It is also related to *Ergone brevidentata* Emerton but has the patellar spur longer and differs in the details of the bulb.

***Eperigone credula*, new species**

Figures 3 and 4

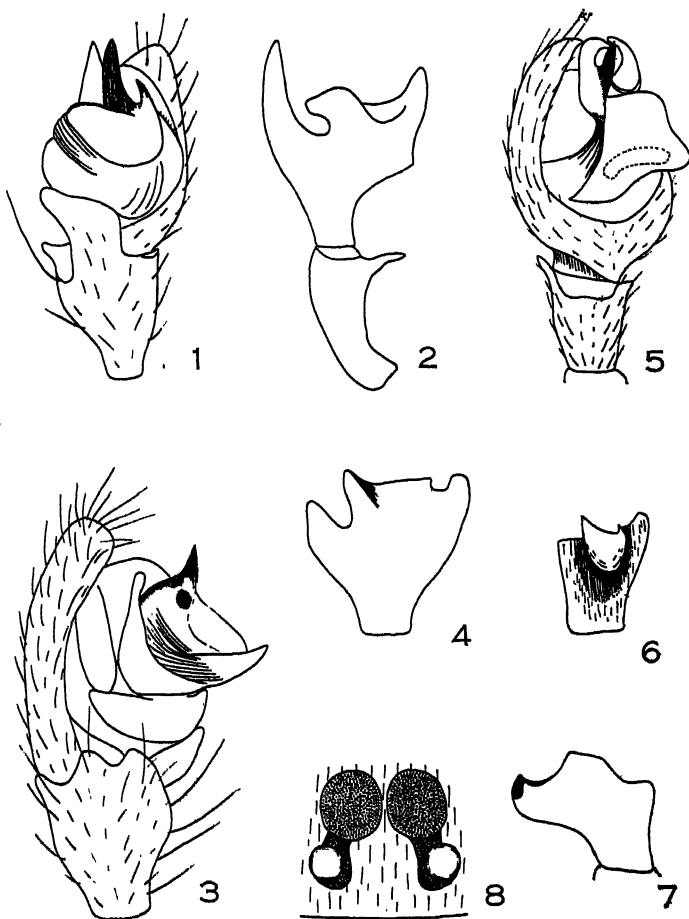
MALE.—Total length, 2.00 mm. Carapace, 1.05 mm. long, 0.74 mm. wide.

Carapace dull yellow to orange, the sides evenly infuscated, the eyes narrowly ringed in black and enclosing a black field, the midline with a row of weak erect hairs, the carapace otherwise clothed with a few scattered inconspicuous black hairs. Sternum dusky, the mouth parts and legs dull yellow, clothed with black hairs. Abdomen nearly black, with a dorsal gray area above and marked with small scattered pale spots.

Carapace longer than broad, suboval, the pars cephalica somewhat narrower, the width of the head at the second eye row five-sevenths of the greatest width. Carapace as viewed from the side rather high, strongly convex, highest at the ocular area, evenly declining caudally to the margin, the cervical groove a longitudinal furrow. Clypeus weakly concave, as high as the length of the median ocular quadrangle. Eyes of the first row slightly narrower than the second, very weakly procurved, the medians separated by the radius, as far from the somewhat larger lateral eyes. Eyes of the second row very weakly procurved, the medians separated by their radius, slightly nearer the subequal laterals. Median ocular quadrangle slightly broader than long (20/19), narrower in front (20/16), the anterior medians somewhat smaller. Lateral eyes subequal and contiguous. Chelicera with a strong tooth on the anterior face near the upper margin, the sides with a row of very weak tubercles from which small setae originate, the sides with a weak series of striae near the distal end. Sternum as broad as long, the posterior coxae separated by their width. Legs without spines, the first tibia and patella. 0.95 mm. long. Femur of palpus four times as long as broad, curved, armed in the basal half below with four or five setigerous bristles. Patella longer than broad (14/10). Tibia longer than the patella (24/14). greatly enlarged distally, the dorsolateral angle produced into a broad bifid process, leaving a conspicuous concavity on the retrolateral side. Details of palpus almost identical with *Eperigone antraea* Crosby and also approximating that of *Eperigone taño* Chamberlin and Ivie.

TYPE LOCALITY.—Llano, Llano County, Texas, December 24, 1935 (L. I. Davis).

This species is closely related to *Eperigone antraea* Crosby but is distinct in the more prominent dorsal teeth on the tibial apophysis and in



- Fig. 1. *Erigone personata*, new species, right palp, ventral view.  
 Fig. 2. Idem, patella and tibia of right palp, retrolateral view.  
 Fig. 3. *Eperigone credula*, new species, right palp, subretrolateral view.  
 Fig. 4. Idem, tibia of right palp, dorsal view.  
 Fig. 5. *Tapinocyba conspecta*, new species, right palp, subventral view.  
 Fig. 6. Idem, tibia of right palp, dorsal view.  
 Fig. 7. Idem, tibia of right palp, retrolateral view.  
 Fig. 8. *Chorisomma minorata*, new species, epigynum.

having the posterior eyes much more closely spaced, being separated by the radius rather than by nearly the diameter. It is also closely related to *Eperigone taibo* Chamberlin and Ivie but differs in the eye arrangement and in the details of the palpus.

***Tapinocyba conspecta*, new species**

Figures 5, 6 and 7

**MALE.**—Total length, 2.10 mm. Carapace, 1.00 mm. long, 0.75 mm. wide.

Carapace bright yellow to orange, paler behind, the eyes narrowly ringed with black and enclosing a black field, armed with a few weak bristles on the midline and on the clypeus. Sternum pale yellow, with a faint dusky marginal band, set sparsely with erect black hairs. Mouth parts and coxae pale yellow. Legs very pale yellow throughout, clothed with rows of black hairs. Abdomen gray to white, the spinnerets with a narrow incomplete black ring, sparsely clothed with black hairs.

Carapace longer than broad, the head broad, the width at the second eye row two-thirds the greatest width. Pars thoracica oval, moderately convex, the pars cephalica much higher, the highest point being just behind the eyes. Clypeus gently rounded, equal in height to twice the length of the median quadrangle. Eyes of the first row procurved, the medians separated by one-third their diameter, as far from the much larger lateral eyes. Second row of eyes very weakly procurved, essentially straight, the medians separated by three-fourths their diameter, a little nearer the subequal laterals. Median ocular quadrangle broader than long (16/13), narrower in front (16/12), the anterior medians much smaller. Lateral eyes of each side subequal and subcontiguous. Cephalic pit beginning between the posterior lateral eyes and continuing behind as a long groove. Chelicera with a strong distal tooth near the inner margin of the outer face and with a row of weak setigerous bristles on each side. Upper and lower margins of the furrow of the chelicera with five subequal denticles. Sternum as broad as long. Labium longer than broad (16/11). Endites moderately convergent, the distal outer margin with a weak setigerous tubercle. Tibia and patella of the first leg. 1.05 mm. long. Details of the palpus as figured.

**TYPE LOCALITY.**—Male holotype from Llano, Llano County, Texas, December 24, 1935 (L. I. Davis). Two male paratypes from Edinburg, Texas, July, 1934 (S. Mulaik).

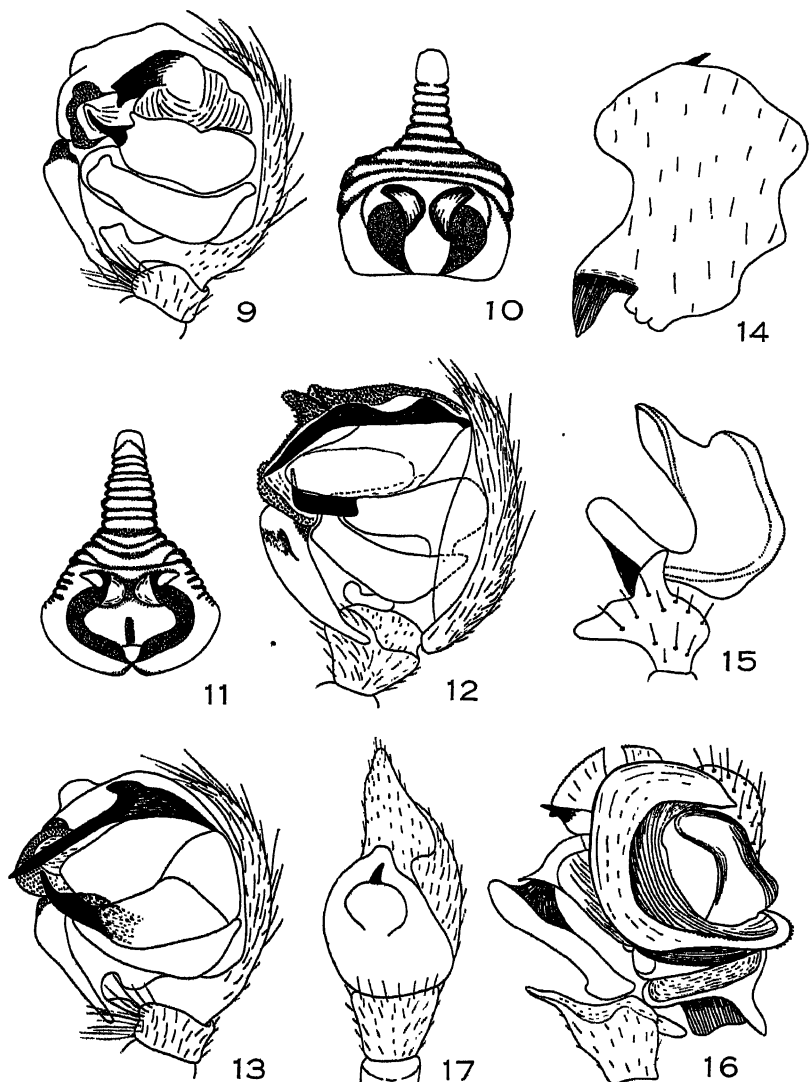
***Floricomus mulaiki*, new species**

Figures, 28, 29, 30 and 31

**MALE.**—Total length, 1.34 mm. Carapace, 0.63 mm. long, 0.55 mm. wide.

Carapace dusky brown, with paler radiating lines, the eyes narrowly ringed in black and enclosing a black field. Sternum and labium dusky brown, paler in the center. Endites and coxae dusky yellow, the legs yellowish brown. Dorsum of the abdomen covered with the usual large orange scutum which is set with a uniform covering of large appressed hairs. Venter mainly dusky, with lighter streaks and markings.

Carapace longer than broad, the pars thoracica oval in outline as seen from above, convex, rather low, the cervical groove indistinct. Pars cephalica greatly



- Fig. 9. *Eustala brevispina*, new species, right palpus, subventral view.  
 Fig. 10. Idem, epigynum.  
 Fig. 11. *Eustala rosae* Chamberlin and Ivie, epigynum.  
 Fig. 12. Idem, right palpus, subventral view.  
 Fig. 13. *Eustala cameronensis*, new species, right palpus, subventral view.  
 Fig. 14. *Microneta llanoensis*, new species, cymbium of right palpus, dorsal view.  
 Fig. 15. Idem, tibia and bulbal apophysis of right palpus, dorsal view.  
 Fig. 16. Idem, right palpus, ventral view.  
 Fig. 17. *Theridion credulum*, new species, right palpus, subventral view.

elevated, the eye group on a conspicuous tubercle, as viewed from the side sharply ascending behind to the pars thoracica, the clypeus very high, with a prominent rounded lobe just below the eye tubercle which is set with short erect black hairs. Eyes all situated in a compact group near the top of the cephalic tubercle. Eyes of the first row placed on the anterior face of the tubercle, in a straight line, the medians slightly separated, subcontiguous with the subequal laterals. Posterior row of eyes in a straight line, the medians much higher than the laterals, separated by a radius, a little farther from the slightly smaller lateral eyes. Median ocular quadrangle broader than long (11/8), as wide in front as behind. Clypeus twice as high as the length of the median eye quadrangle. Sternum as broad as long, squared off in front, gently rounded on the sides, truncated between the posterior coxae which are separated by their width. Labium broader than long. Legs set with rows of fine black hairs, the first patella and tibia, 0.55 mm. long. Palpus as figured. Abdomen a broad oval as seen from above.

FEMALE.—Total length, 1.35 mm.

Color and structure essentially as in the male except for the pars cephalica which is normal in shape. Eyes of the first row straight, the medians slightly separated, subcontiguous with the subequal laterals. Second row of eyes very weakly procurved, essentially straight, the medians separated by a little less than the radius, a radius from the subequal laterals. Median ocular quadrangle slightly longer than broad, as wide in front, the eyes subequal. Epigynum as figured.

TYPE LOCALITY.—Male holotype and paratype, female allotype and paratypes from Cameron County, Texas, May 1 and 2, 1936 (L. I. Davis).

This interesting species has a strongly elevated cephalic tubercle as in *Floricomus crosbyi* Ivie and Barrows but is distinct in having all the eyes in a compact group at the summit of the tubercle.

### Agelenidae

#### *Chorizomma minorata*, new species

Figure 8

FEMALE.—Total length, 1.60 mm. Carapace, 0.70 mm. long, 0.47 mm. wide.

Whole spider white to very pale yellow, without dark markings except for the very narrow black rings around the eyes. Clothing as usual in the genus or as in *Cicurina*, a thin covering of fine black hairs.

Carapace longer than broad, rather weakly convex, slightly rounded on the sides, truncated in front, the width at the second eye row about two-thirds the greatest width of the carapace (32/47). Sutures obsolete. Carapace as viewed from the side nearly equal in height for five-sevenths of the length and from that point evenly sloping to the caudal margin. Clypeus equal in height to one-half the diameter of an anterior lateral eye. Eyes six, the anterior laterals (first row) separated by their diameter. Posterior row of eyes straight, the medians separated by their long diameter, subcontiguous with the posterior laterals and with the anterior laterals. All eyes subequal. Sternum longer than broad (45/37), suboval, the posterior coxae separated by their width. Labium twice as broad as long (15/7), scarcely half as high as the endites. Chelicera armed with five small subequal teeth on the lower

margin of the furrow. Legs rather robust, the first tibia and metatarsus with two pairs of ventral spines, no distals, and with a single prolateral. First leg: femur 0.46 mm., patella, 0.22 mm., tibia, 0.33 mm., metatarsus, 0.30 mm., and tarsus, 0.24 mm. long. Epigynum as figured.

TYPE LOCALITY.—Female holotype from San Antonio, Texas, December, 1934 (L. I. Davis).

This species is readily separated from *Chorizomma texana* Gertsch by its much smaller size, in having the eyes subequal, and in the greater separation of the posterior median eyes.

### Theridiidae

#### *Dipoena jocosa*, new species

Figure 20

FEMALE.—Total length, 2.25 mm. Carapace, 0.80 mm. long, 0.80 mm. wide.

Carapace dark reddish brown, clothed sparsely with short pale hairs. Sternum dark reddish brown, the mouth parts and coxae paler, the clothing of the underside inconspicuous hairs. Integument of the legs pale yellow, but the bright color masked more or less completely by brown, the basal half of the first femur pale, the distal half of the femur and the remaining joints of the first leg mainly brown. Other legs as the first but the dorsum of the joints with an inconspicuous pale band. Abdomen mainly gray, the dorsum with a broad white transverse stripe between the shoulder humps, the venter with a broad triangular dark band which encloses a white maculation.

Carapace as broad as long, moderately high, convex, the highest point at the second coxae, the cervical groove obsolete. First row of eyes straight, the medians separated by two-thirds their diameter, subcontiguous with the slightly smaller lateral eyes. Eyes of the second row straight, the medians separated by nearly three-fourths their diameter, as far from the subequal laterals. Median ocular quadrangle broader than long (25/22), wider in front in the same ratio, the eyes subequal. Clypeus sloping, a little higher than the diameter of an anterior median eye. Sternum longer than broad (50/43), truncated in front, very weakly rounded on the sides truncated behind where the posterior coxae are separated by their length. Labium much broader than long, half as high as the endites. Legs without spines. First leg: femur, 0.86 mm., patella, 0.36 mm., tibia, 0.53 mm., metatarsus, 0.50 mm., and tarsus, 0.45 mm. long. Abdomen broader than long (2.60 mm./1.70 mm.), very high and overlapping the carapace, armed with a prominent shoulder hump on each side. Vulva a simple elliptical aperture.

MALE.—Total length, 1.10 mm. Carapace, 0.54 mm. long, 0.50 mm. wide.

Carapace dark reddish brown as in the female. Legs paler than in the female distinctly annulate. Abdomen mainly white in the caudal portion, the venter with a black stripe which encloses a white marking.

Structure of the carapace essentially as in the female, a little higher and more convex, the sutures obsolete, the front gently rounded. Clypeus equal in height to one and one-third times the diameter of an anterior median eye. Eyes of the first row straight, the medians separated by about two-thirds their diameter, subcontiguous with the subequal laterals. Second eye row weakly recurved, essentially straight,

the medians separated by their radius, two-thirds their diameter from the subequal laterals. Median ocular quadrangle broader than long (18/15), narrowed behind in the same ratio, the eyes subequal. Lateral eyes subcontiguous and subequal. Legs without spines, the first patella and tibia, 0.50 mm. long. Palpus as figured. Abdomen strongly humped as in the female.

**TYPE LOCALITY.**—Male holotype, female allotype and male and female paratypes from Austin, Texas, August, 1935 (L. I. Davis). Edinburg, Texas, October 15, 1935, female paratype (Schulle). Female paratype from thirty miles west of Edinburg, Texas, April 24, 1934 (S. Mulaik). Female paratype from Llano, Texas, August, 1935 (L. I. Davis).

#### CALODIPOENA, NEW GENUS

A genus of the subfamily Latrodectinae.

Tarsal claws pectinate. Carapace about as broad as long, convex, the pars cephalica elevated in the male. First row of eyes procurved, the medians widely separated, contiguous with the subequal laterals. Second eye row very weakly procurved, the eyes equidistantly spaced, the medians larger. Median ocular quadrangle broader in front in the male, less so in the female, the anterior medians smaller. Sternum as broad as long, truncated behind, the posterior coxae separated by the length of the fourth metatarsus. Abdomen globose.

**GENOTYPE.**—*Calodipoena incredula*, new species.

This genus is distinct from *Dipoena* in the relations of the eyes, in having the eyes of the first row subequal, and in having the sternum broadly truncated caudally. It differs from *Dipoenoides* in having the eyes of the first row subequal, rather than much smaller than the laterals.

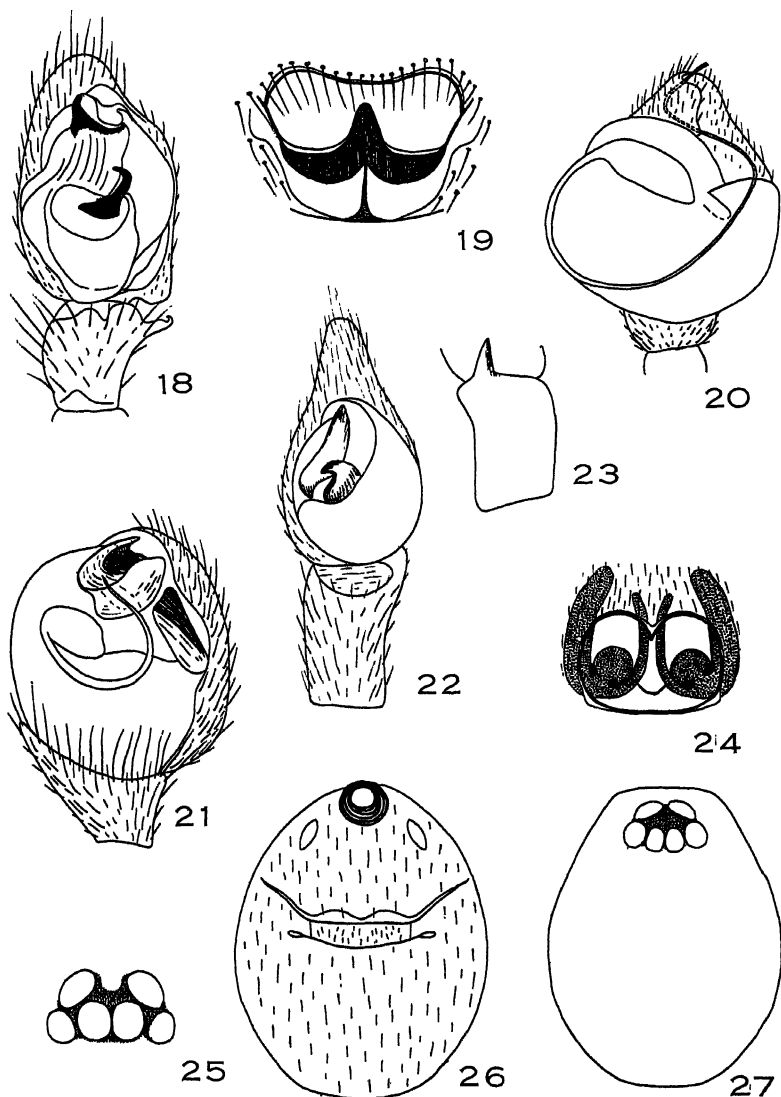
#### *Calodipoena incredula*, new species

Figures 32 and 33

**FEMALE.**—Total length, 0.80 mm. Carapace, 0.30 mm. long, 0.28 mm. wide.

Carapace black on the sides including the clypeus, medially with a broad black band which encloses the eye group and passes back to the posterior declivity which is pale yellow. Sternum pale yellow, with four large dark maculations at the corners, with a clothing of erect inconspicuous hairs. Labium, mouth parts and coxae pale yellow. Tarsi of the legs light brown, the other joints dusky, with broad darker terminal rings that in some cases nearly completely darken the joints. Abdomen black above, with two recurved transverse rows of four large white spots; sides and upper part of the abdomen with numerous smaller white spots; venter with a broad pale band which passes caudad far behind the spinnerets and which encloses several transverse brown bands.

Carapace nearly as broad as long, about equal in height from the eyes to the posterior declivity, moderately convex and moderately high, the sutures indistinct. Eyes of the first row weakly procurved, the dark medians separated by their diameter, contiguous with the subequal white laterals. Clypeus with a transverse groove be-



- Fig. 18. *Zorocrates alternatus*, new species, left palpus, ventral view.  
 Fig. 19. Idem, epigynum.  
 Fig. 20. *Dipoena jocosa*, new species, right palpus, ventral view.  
 Fig. 21. *Theridion submissum*, new species, right palpus, ventral view.  
 Fig. 22. *Micaria vinnula*, new species, left palpus, ventral view.  
 Fig. 23. Idem, tibia of left palpus, subdorsal view.  
 Fig. 24. Idem, epigynum.  
 Fig. 25. *Opopaea meditata*, new species, eyes of female.  
 Fig. 26. Idem, venter of abdomen of female.  
 Fig. 27. *Stenoconops (?) juvenilis*, new species, carapace of male, dorsal view.



low the eyes, equal in height to the diameter of an anterior median eye. Second row of eyes straight, the medians separated by a radius, as far from the subequal laterals. Median ocular quadrangle slightly broader than long, slightly wider in front, the anterior medians a little smaller. Tibia and patella I, 0.30 mm. long; IV, 0.25 mm. long. Tarsi pectinate. Abdomen strongly elevated, globose, slightly overlapping the carapace in front, the spinnerets located near the genital groove. Epigynum not fully developed.

MALE.—Total length, 0.62 mm. Carapace, 0.27 mm. long, 0.30 mm. wide.

Color of the carapace and abdomen as in the female. Carapace slightly broader than long, convex, more strongly elevated in the female, the pars cephalica decidedly higher. Eyes of the first row procurved, the medians separated by a little more than their diameter, contiguous with the subequal laterals. Second row of eyes weakly procurved, essentially straight, the medians separated by their radius, as far from the smaller laterals. Median ocular quadrangle broader than long (13/10), much wider in front in the same ratio, the posterior median eyes larger. Clypeus gently sloping, twice as high as the diameter of an anterior median eye. Claws pectinate. Abdomen not so strongly elevated as in the female. Palpus as figured.

TYPE LOCALITY.—Male holotype, immature female allotype and paratype from Cameron County, Texas, May 1 and 2, 1936 (L. I. Davis).

#### *Theridion submissum*, new species

##### Figure 21

MALE.—Total length, 2.15 mm. Carapace, 0.97 mm. long, 0.85 mm. wide.

Carapace pale-yellowish brown, the sides of the pars thoracica infuscated, the dorsum with an elongate triangular dark maculation which begins at the posterior declivity and passes forward to include the ocular area. Eyes narrowly ringed in black. Sternum, mouth parts and coxae pale yellow, the margins of the sternum lightly infuscated, the whole underside very sparsely set with black hairs. Anterior legs missing, the posterior ones pale yellow, very narrowly annulate at the distal ends of the tibiae and metatarsi. Integument of the abdomen pale yellow, the dorsum with a median longitudinal white stripe the whole length, the sides strongly marked with black reticulations, the venter lightly infuscated in front.

Carapace longer than broad, moderately high, rather evenly convex, the clypeus rounded, the cephalic sutures and cervical groove weakly indicated. Pars cephalica at the second eye row half as broad as the greatest width of the carapace. Clypeus convex as seen from the side, twice as high as the diameter of an anterior median eye. Eyes of the first row straight from in front, the medians separated by scarcely their diameter, subcontiguous with the subequal laterals, separated by about half the radius. Eyes of the second row very weakly procurved, essentially straight, the medians separated by two-thirds their short diameter, as far from the slightly smaller lateral eyes. Median ocular quadrangle broader than long (24/22), slightly wider in front in the same ratio, the eyes subequal. Sternum as broad as long, subtriangular, bluntly rounded behind, the posterior coxae separated by their width. Labium twice as broad as long. Abdomen three-fourths as broad as long, oval in outline moderately elevated. Second femur, 1.10 mm. long. Fourth patella and tibia, 1.00 mm. long. Palpus rather robust, the details as figured. This species belongs

in the group of which *Theridion murarium* Emerton, *T. placens* Keyserling and *T. frondeum* Hentz are typical and can be separated by the details of the palpus.

TYPE LOCALITY.—Male holotype from Chisos Mountains, Brewster County, Texas, July, 1935 (L. I. Davis).

*Theridion credulum*, new species

Figure 17

MALE.—Total length, 1.20 mm. Carapace, 0.65 mm. long, 0.50 mm. wide.

Carapace dull yellowish brown, evenly infuscated with brown, sparsely streaked in brown, with a few black hairs in the ocular region, the eyes ringed in black. Sternum, labium and endites brown, set with a few scattered weak black hairs. Legs yellowish brown, with inconspicuous darker annulae. Abdomen for the most part gray, with two irregular lines of white spots on the dorsum, the venter with a broad black stripe that surrounds the spinnerets.

Carapace longer than broad, rather low, weakly convex, highest near the front but nearly equally high behind to the posterior declivity. Clypeus one and one-half times as high as the diameter of an anterior median eye. Eyes of the first row practically straight, the medians separated by a little more than the radius, less than half as far from the smaller laterals. Second row of eyes straight, the medians separated by three-fourths their diameter, two-thirds their diameter from the subequal laterals. Median ocular quadrangle as broad as long, very slightly wider in front, the anterior medians a little larger. Sternum as broad as long, cordate, the posterior coxae separated by their width. Labium twice as broad as long, a third as high as the endites. First leg: femur, 1.00 mm. patella, 0.30 mm., tibia, 0.77 mm., metatarsus, 0.80 mm. and tarsus, 0.40 mm. long. Legs without true spines, set with rows of black hairs. Palpus as figured.

TYPE LOCALITY.—Male holotype from Cameron County, Texas, January to March, 1936 (L. I. Davis).

Linyphiidae

*Microneta llanoensis*, new species

Figures 14, 15 and 16

MALE.—Total length, 2.00 mm. Carapace, 0.90 mm. long, 0.75 mm. wide.

Carapace dull yellow to light yellowish brown in color, armed sparsely with a few weak spines, the eyes ringed in black and enclosing a dusky area. Mouth parts, sternum and legs concolorous with the carapace, the former with a few short inconspicuous hairs, the legs with rows of hairs but without spines.

Carapace longer than broad, convex, broad in front, the width at the second eye row five-sevenths the greatest width of the carapace (55/75). Clypeus rounded, slightly sloping, equal in height to three and one-half times the diameter of an anterior median eye. Pars cephalica highest just behind the eye group, convex, the cephalic sutures and the cervical groove nearly obsolete. Eyes of the first row straight as seen from in front, the medians subcontiguous, separated from the larger laterals by two-thirds the diameter. Eyes of the second row essentially straight, the medians separated by three-fourths their diameter, as far from the subequal lateral eyes. Median ocular quadrangle broader than long (17/12), wider behind in the same ratio,

the eyes subequal. Chelicera longer than broad, the upper margin with five unequal teeth, the lower margin with four small subequal teeth which are placed near the base of the claw. Chelicera furnished on the outer side with a file-like series of ridges as usual in the family. Sternum broader than long (24/22), broadly truncated in front, weakly rounded on the side, bluntly pointed between the posterior coxae which are separated by their width. Labium broader than long. First leg: femur, 1.10 mm., patella, 0.25 mm., tibia, 1.30 mm., metatarsus, 1.10 mm. and tarsus, 0.80 mm. long. Details of the palpus as figured.

TYPE LOCALITY.—Male holotype from Llano, Llano County, Texas, December, 1934 (L. I. Davis).

### Argiopidae

#### *Eustala brevispina*, new species

Figures 9 and 10

MALE.—Total length, 5.50 mm. Carapace, 2.53 mm. long, 2.27 mm. wide.

Integument of the carapace pale yellow, medially with a broad irregularly margined brown band which includes most of the dorsum and is variegated with round black spots, the sides pale, the eyes ringed with black. Clothing of the carapace short procumbent black hairs on the darker pattern, the pale areas with white hairs, those in front longer. Sternum dull yellow, irregularly margined with black. Labium and endites brown, the distal margins white. Coxae from beneath margined with black. Legs dull yellow, strongly marked in black, the femora mainly black above, especially so the last one, the other joints with dark terminal annulae. All the joints otherwise variegated with numerous black spots. Dorsum of the abdomen brownish gray, with a narrow black median longitudinal band, an indistinct triangular folium and two small white spots at the base. Venter of the abdomen with a broad dark median band.

Carapace somewhat longer than broad, moderately elevated, flat above, the cervical groove a deep longitudinal depression. Pars cephalica higher than the thoracic portion, the ocular region protruding beyond the clypeal margin, the cephalic striae indistinct. Sides of the carapace convex, dropping abruptly from the flattened dorsum. Eyes of the first row essentially straight as seen from in front, strongly recurved as viewed from above, the medians separated by their diameter, about as far from the much smaller laterals which eyes are elevated on conspicuous tubercles. Eyes of the second row strongly recurved, the medians about three times as far from the subequal laterals. Median ocular quadrangle broader than long (53/45), much wider in front (53/40), the anterior medians much larger (in ratio of 21:14). Clypeus as high as the diameter of an anterior median eye. Sternum longer than broad (55/-45), the posterior coxae subcontiguous. Labium three-fifths as long as broad. First coxa with a distal ventral spur on the retrolateral side. First leg: femur, 4.35 mm., patella, 1.40 mm., tibia, 3.50 mm., metatarsus, 3.00 mm. and tarsus, 1.00 mm. long. First tibia with six pairs of weak ventral spines, the last pair distal. Palpus as figured, characterized particularly by the very short embolus which is like that of no other described species. Abdomen subtriangular, somewhat pointed and truncated behind, with a weakly developed caudal tubercle.

FEMALE.—Total length, 8.00 mm. Carapace, 2.70 mm. long, 2.50 mm. wide.

Carapace uniform reddish brown in color, the eyes narrowly ringed with black. Sternum and mouth parts pale yellow, lightly infuscated. Legs less strongly maculate than in the male. Abdomen with a well-marked dorsal folium, the venter with a median longitudinal dark band which is divided by a white stripe.

Structure as usual in females of the genus, the carapace nearly as broad as long, very broad in front, the clypeus vertical, the pars cephalica not strongly protruding beyond it. Eyes of the first row essentially straight from in front, recurved as seen from above, the medians separated by nearly one and one-half times the diameter, twice as far from the much smaller laterals which are elevated on very weak tubercles. Second row of eyes recurved. The medians separated by about the diameter, four diameters from the smaller laterals. Median ocular quadrangle broader than long (48/43), wider in front (48/42), the eyes subequal. Clypeus scarcely as high as the diameter of an anterior median eye. First leg: femur, 3.00 mm., patella, 1.30 mm., tibia, 2.70 mm., metatarsus, 2.45 mm., and tarsus, 0.80 mm. long. Abdomen subtriangular, with a conspicuous caudal tubercle and a smaller tubercle below it, essentially as in *Eustala rosae* Chamberlin and Ivie. Epigynum as figured.

TYPE LOCALITY.—Male holotype from Cameron County, Texas, December, 1934 (L. I. Davis). Female allotype and paratypes from Brownsville, Texas, May 25, June 1 and June 8, 1934 (J. N. Knull).

#### *Eustala cameronensis*, new species

Figure 13

MALE.—Total length, 3.50 mm. Carapace, 1.90 mm. long, 1.60 mm. wide.

Color and pattern of carapace agreeing in detail with that of the male of *Eustala brevispina*, new species. Sternum mainly black, paler in the middle, the labium and endites black, distally pale. Legs pale yellow, the femora darkened in the distal half, the tibiae and metatarsi with distal dark rings and inconspicuous basal annulae. Abdomen gray to brown above, with a well marked broad folium, the venter with a dark band which encloses a white spot.

Structure of the carapace as in the male of *brevispina*. Eyes of the first row essentially straight as seen from in front, the medians separated by a little more than their diameter, a little farther from the much smaller laterals which are elevated on distinct tubercles. Eyes of the second row recurved, the medians separated by their diameter, three times as far from the much smaller lateral eyes. Median ocular quadrangle broader than long (4/3), wider in front in the same ratio, the anterior medians larger. Clypeus equal in height to the diameter of an anterior median eye. Sternum longer than broad (75/60), the posterior coxae subcontiguous. Labium broader than long (35/18). First coxae with a distal ventral spur placed on the retrolateral side. First tibia with five pairs of ventral spines, the last pair distal. First leg: femur, 3.30 mm., patella, 0.95 mm., tibia, 2.24 mm., metatarsus, 2.00 mm., and tarsus, 0.70 mm. long. Palpus as in other species of the genus, e.g., *Eustala anastera*, *rosae*, etc., the embolus a long spine, the conductor setose but not greatly enlarged as in *anastera*, the appended apophysis (clavis of F. Cambridge) as usual in the genus. Median apophysis (uncus) of the bulb proportionately shorter than in other species. Abdomen subtriangular in shape, narrowed behind, without dorsal or terminal tubercles.

TYPE LOCALITY.—Male holotype from Cameron County, Texas, January to March, 1936 (L. I. Davis).

This is a much smaller species than *Eustala rosae* Chamberlin and Ivie or *Eustala brevispina*, new species. The abdomen is not tuberculate as in these species and it differs in the details of the palpus.

***Eustala rosae* Chamberlin and Ivie**

Figures 11 and 12

*Eustala rosae* CHAMBERLIN AND IVIE, 1935, Bull. Univ. Utah (Biological Series, II (No. 8)), XXVI, p. 22, Pl. xv, Fig. 124.

RECORD.—Cameron County, Texas, January to March, 1936, male (L. I. Davis).

**Zoropsidae**

***Zorocrates alternatus*, new species**

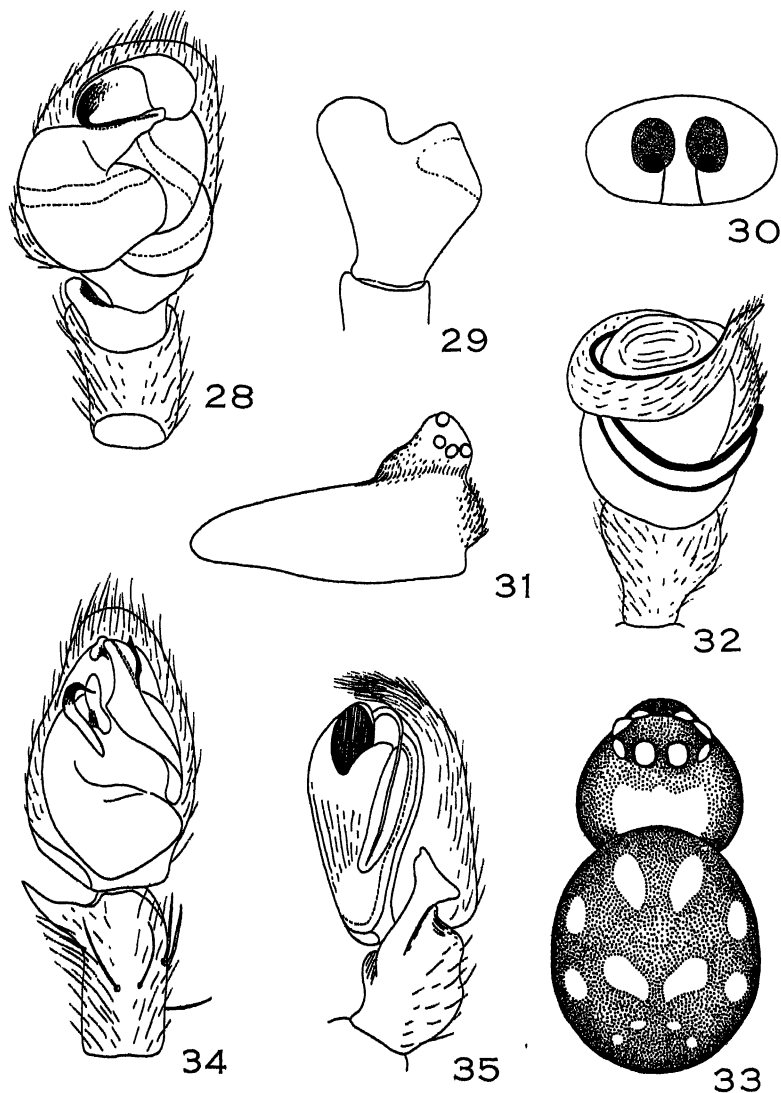
Figures 18 and 19

MALE.—Total length, 5.00 mm. Carapace, 2.70 mm. long, 2.00 mm. wide. Abdomen, 2.20 mm. long, 1.50 mm. wide.

Integument of the carapace dull yellowish brown, very sparsely clothed with fine black hairs. Margins of the carapace dusky, the dorsum with two irregular longitudinal dusky bands, the intervals between them a pale stripe which is weakly constricted at the cervical groove. Eyes ringed with black. Sternum, mouth parts and coxae dull yellow, evenly but sparsely clothed with erect short black hairs. Chelicerae light reddish brown, clothed with longer black hairs. Legs pale yellow basally, slightly browner toward the distal ends, sparsely clothed with black hairs and set with strong spines. Abdomen gray to black above, with a median pattern of pale spots, the sides of the venter flecked with black, the venter pale yellow. Clothing of the abdomen inconspicuous black hairs.

Carapace longer than broad, convex, slightly highest at the longitudinal cervical groove, the cephalic sutures poorly indicated. Pars cephalica at the eyes half as wide as the greatest width of the carapace. Clypeus half as high as the diameter of an anterior median eye. First row of eyes procurved, slightly recurved as seen from above, the median eyes separated by about one-third their diameter, slightly nearer the larger laterals. Second row of eyes slightly broader than the first, essentially straight, the medians separated by their radius, scarcely a diameter from the subequal laterals. Median ocular quadrangle longer than broad (35/30), narrowed in front (30/25), the anterior medians smaller. Lateral eyes subequal. Sternum longer than broad (13/11), suboval, the anterior coxae separated by nearly their length, the posterior coxae subcontiguous. Labium slightly longer than broad (40/38), subquadrangular, four-sevenths as high as the endites. Chelicera with three subequal teeth on the lower margin, with three on the upper of which the median one is larger.

Leg formula, 4123. All tarsi scopulate beneath. First leg: femur, 2.00 mm., patella, 1.10 mm., tibia, 2.00 mm., metatarsus, 2.00 mm., and tarsus, 1.35 mm. long. Tibia and patella of the fourth leg, 3.20 mm. First tibia with four pairs of ventral spines, the last pair distal. Palpus as figured.



- Fig. 28. *Floricomus mulaiki*, new species, right palpus, ventral view.  
 Fig. 29. Idem, tibia of right palpus, retrolateral view.  
 Fig. 30. Idem, epigynum.  
 Fig. 31. Idem, carapace of male, lateral view.  
 Fig. 32. *Calodipoena incredula*, new species, right palpus, subventral view.  
 Fig. 33. Idem, carapace and abdomen of male, dorsal view.  
 Fig. 34. *Drassyllochemmis captiosus*, new species, right palpus, ventral view.  
 Fig. 35. *Clubiona adjacens*, new species, right palpus, retrolateral view.

**FEMALE.**—Total length, 7.50 mm. Carapace, 3.10 mm. long, 2.30 mm. wide.

Color and structure essentially as in the male. First leg: femur, 2.00 mm., patella, 1.05 mm., tibia, 1.80 mm., metatarsus, 1.40 mm. and tarsus, 0.90 mm. long. Tibia and patella of the fourth leg, 3.30 mm. long. Spines beneath the first tibiae as in the male but less robust. Epigynum as figured.

**TYPE LOCALITY.**—Male holotype and paratype and female allotype and paratype from east of Harlingen, Texas, January to March, 1936 (L. I. Davis).

This small species is closely related to *Zorocrates aemulus* Gertsch which is also from Texas and resembles it in general appearance. The differences in the palpi and epigyna, however, are considerable and the species may be easily separated by reference to them.

#### *Zorocrates isolatus*, new species

**FEMALE.**—Total length, 9.20 mm. Carapace, 4.00 mm. long, 2.80 mm. wide.

Integument of the carapace bright yellow-brown, sparsely clothed with fine black hairs, the ocular region and the clypeus with a series of long black hairs that overlap the chelicerae. Margins of the carapace slightly infuscated, the dorsum with very faintly indicated, dark long bands which are accentuated by the black hairs. Chelicerae reddish brown. Sternum, mouth parts and coxae bright yellowish brown, evenly clothed with erect black hairs. Legs concolorous with the carapace, a little darkened distally, clothed with fine black hairs. Abdomen uniform gray above, paler beneath, very much rubbed and damaged.

Carapace longer than broad, moderately convex, the cervical groove longitudinal. Pars cephalica at the eyes three-fifths as broad as the greatest width of the carapace, the cervical sutures very slightly evident. Front truncated, the clypeus half as high as the diameter of an anterior median eye. First row of eyes weakly procurved, the medians separated by two-thirds their radius, a little nearer the larger laterals. Posterior row of eyes very weakly procurved, essentially straight, the medians separated by about two-thirds their diameter, fully a diameter from the subequal laterals. Lateral eyes subequal. Median ocular quadrangle longer than broad (53/48), slightly narrowed in front (48/43), the anterior medians smaller. Labium slightly longer than broad (75/72), subquadrangular, seven-twelfths as high as the parallel endites. Sternum longer than broad (95/80), suboval, the posterior coxae subcontiguous. Chelicera with three subequal teeth on the lower margin, the upper with three of which the middle one is larger.

Leg formula, 4123. Tarsi of all legs and the metatarsi of the first two pairs scopulate beneath. First leg: femur, 3.50 mm., patella, 1.80 mm., tibia, 3.30 mm., metatarsus, 2.50 mm., and tarsus, 1.40 mm. long. Tibia and patella of the fourth leg, 5.10 mm. long. First leg without spines above, except for two dorsals on the femur. First tibia with 2-2-2-1-2 ventral spines, the metatarsus with 2-2-2 ventral spines; otherwise both joints unarmed.

**TYPE LOCALITY.**—Immature female holotype from Chisos Mountains, Brewster County, Texas, July, 1935 (L. I. Davis).

The only specimen of this species is immature but presents numerous differences from *Zorocrates aemulus* and *alternatus*, chiefly in the posses-

sion of more than four pairs of ventral spines beneath the first tibiae and in the much greater size. *Zorocrates isolatus*, new species, is more closely related to *Zorocrates mistus* Cambridge and agrees with it in the spinal formula of the legs. It is possibly identical with the immature female from Santa Rosa Valley, Baboquivari Mountains, Arizona, recorded by Gertsch (1935, American Museum Novitates, No. 792, page 23) as *Z. mistus* Cambridge but on the basis of the specimens on hand that cannot be definitely determined.

### Clubionidae

#### DRASSYLOCHEMMIS, NEW GENUS

A genus of the subfamily Liocraninae.

Lower margin of the furrow of the chelicera with two small, well-separated teeth, the upper with three, also well separated. Carapace longer than broad, convex, the width of the head about half the width of the carapace. Eye rows close together, straight, the eyes of the posterior row subequal and subequidistant, the medians of the anterior row smaller and nearer the laterals. Median ocular quadrangle broader than long, narrowed in front. Fourth tibia with two dorsal spines. First tibiae unarmed above, with six pairs of ventral spines. Anterior spinnerets much longer than the posteriors.

GENOTYPE.—*Drassyllochemmis captiosus*, new species.

This species has the anterior spinnerets widely separated and thus resembles the Gnaphosidae, particularly the genera of the subfamily Anagraphidiinae. However, the presence of six pairs of ventral spines beneath the interior tibiae would seem to preclude the possibility of its being a gnaphosid. In other respects it resembles the genus *Anachemmis* Chamberlin from which it may be separated by having only two teeth on the lower margin of the chelicerae.

#### *Drassyllochemmis captiosus*, new species

##### Figure 34

MALE.—Total length, 4.30 mm. Carapace, 2.00 mm. long, 1.63 mm. wide.

Carapace light yellowish brown, clothed sparsely with fine procumbent gray hairs interspersed with which are suberect, more robust, black hairs. Clypeus margined with four elongate spines below the eye row and with three weaker ones on each side. Eyes narrowly ringed in black and including a dusky area. Sternum, mouth parts and coxae pale yellowish brown, clothed with erect black hairs. Legs concolorous with the dorsum, darker distally, clothed with rows of erect black hairs and stout black spines. Abdomen gray to white above, infuscated somewhat on the sides, the venter pale. Clothing of the abdomen a thin covering of long procumbent gray hairs, the base of the dorsum, however, with a patch of stout long curved hairs.

Carapace longer than broad, rather low, moderately and evenly convex, the cephalic sutures obsolete, the cervical groove longitudinal. Width of the carapace at the second eye row less than half the greatest width (75/163). Eyes of the first row



straight, the medians separated by two-thirds their diameter, nearly touching the much larger lateral eyes. Second row of eyes straight, the medians separated by their diameter, as far from the slightly larger lateral eyes. Median ocular quadrangle broader than long (23/15), narrowed in front in the same ratio, the anterior medians smaller. Lateral eyes of each side separated by one-fourth the diameter of the slightly larger anteriors. Clypeus equal in height to one-half the diameter of an anterior median eye. Cervical groove beginning back nearly seven-tenths of the length of the carapace. Upper margin of the furrow of the chelicera with three well-separated teeth, the median larger; the lower margin with two subequal, separated small teeth. Sternum longer than broad (110/86), truncated in front, gently rounded on the sides, bluntly rounded between the posterior coxae which are separated by a little less than half their width. Coxae subequal. Labium broader than long (27/-24), subquadrangular, half as high as the subparallel endites, the latter with a terminal brush of fine black hairs. Anterior spinnerets very long (0.60 mm.), separated by their width, the apical joint very short, set with nine long spinning tubules. Posterior spinnerets three-fourths as long as the anteriors but much less robust, well separated.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.30	0.95	1.30	1.00	0.65	5.20 mm.
II	1.25	0.88	1.15	0.93	0.65	4.86 mm.
III	1.13	0.75	0.96	0.95	0.60	4.39 mm.
IV	1.40	0.95	1.40	1.48	0.80	6.03 mm.

First tibia with six pairs of strong ventral spines, the last pair apical, and with a basal and distal prolateral, otherwise unarmed. First metatarsus with a basal and a submedian ventral pair of spines, otherwise unarmed. Second tibia with four ventral pairs and two prolaterals and retrolaterals, dorsally unarmed. Last legs with strong spines beneath (three pairs) and above. First tarsi with a thin covering of scopular hairs. Palpus as figured.

TYPE LOCALITY.—Male holotype from Cameron County, Texas, May 1 and 2, 1936 (L. I. Davis).

### *Micaria vinnula*, new species

Figures 22, 23 and 24

MALE.—Total length, 2.45 mm. Carapace, 1.28 mm. long, 0.75 mm. wide.

Carapace dark reddish brown, somewhat paler on the thoracic portion, the midline and the sides of the pars cephalica with a few indistinct dark streaks. Carapace clothed sparsely with procumbent white scales, the clypeus with five long hairs projecting over the chelicerae, four marginal and the middle one somewhat above. Chelicerae dark reddish brown. Sternum and mouth parts light yellowish brown, sparsely set with erect black hairs. First femur brown in the basal two-thirds, distally pale yellow, the other joints of the first leg pale yellow. Second leg as the first but the brown on the femur forming side bands. Last legs light brown on the basal joints, the distal ones paler. Dorsum of the abdomen dusky, covered with inconspicuous scales, with a pale ring at the slight constriction of the abdomen in which

the scales are orange. Venter of the abdomen white, with a few scattered orange scales.

Carapace much longer than broad, gently rounded in front and on the sides, strongly rounded caudally, the width of the pars cephalica at the second eye row equaling five-sevenths of the greatest width (55/75), which is between the third coxae. Carapace strongly convex, highest behind the eyes, the median groove an inconspicuous longitudinal slit, the cephalic sutures obsolete. Clypeus equal in height to the diameter of an anterior lateral eye. First row of eyes weakly procurved, the medians separated by their radius, half as far from the subequal laterals. Second row of eyes essentially straight, the eyes subequal and subequidistant, separated by nearly one and one-half times the diameter. Median ocular quadrangle longer than broad (17/15), slightly narrower in front, the posterior eyes slightly smaller. Lateral eyes of each side subequal, separated by one and one-half times their diameter. Lower margin of the furrow of the chelicera apparently unarmed. Leg formula, 4123, the femora with a dorsal spine near the base, the first legs otherwise unarmed, the last two legs with weak ventral spines on the tibiae and metatarsi. First leg: femur 0.70 mm., patella, 0.32 mm., tibia, 0.60 mm., metatarsus, 0.48 mm., and tarsus, 0.44 mm. long. Fourth leg: femur, 0.80 mm., patella, 0.33 mm., tibia, 0.66 mm., metatarsus, 0.73 mm., and tarsus, 0.40 mm. long. Palpus as figured.

FEMALE.—Total length, 2.10 mm. Carapace, 1.08 mm. long, 0.66 mm. wide.

Coloration and structure essentially as in the male. Epigynum as figured.

TYPE LOCALITY.—Male holotype and female allotype from San Antonio, Texas, December 28, 1935 (L. I. Davis).

This species closely approximates *Micaria swansoni* Gertsch and Mulaik in color but is distinct in the eye relations and the details of the palpus. The tibial apophysis of the male palpus is more strongly developed than in *swansoni*. Both species have the carapace very broad as in *Micaria nanella* Gertsch but have a much shorter tibial apophysis.

### *Clubiona adjacens*, new species

Figure 35

MALE.—Total length, 2.30 mm. Carapace, 1.05 mm. long, 0.75 mm. wide.

Whole spider pale yellow except for the narrow black rings around the eyes and the brown tibia and tarsus of the palpus. Carapace clothed sparsely, the abdomen more thickly with inconspicuous white hairs. Spines of the legs black.

Carapace longer than broad, moderately high, the head sutures and cervical groove obsolete. Structure as in other species of the *abboti* group. Eyes of the first row marginal, the clypeus scarcely evident, the medians separated by a radius, half as far from the subequal laterals. Eyes of the second row straight, the medians separated by nearly two diameters, half as far from the subequal lateral eyes. Median ocular quadrangle broader than long (25/16), narrower in front in the same ratio. All eyes subequal. Eye group nearly as wide as the pars cephalica at the second eye row. Sternum longer than broad (60/43), truncated in front, narrowly rounded on the sides, bluntly pointed behind, the posterior coxae separated by one-third their width. Lower cheliceral margin with three small teeth. First leg: femur, 0.72 mm., patella, 0.38 mm., tibia, 0.64 mm., metatarsus, 0.48 mm., and tar-

sus, 0.30 mm. long. Tibiae of the first two legs with a broad basal and a median pair of spines, no distals; metatarsi of these legs with a single basal pair of spines. Tibia of the first two legs without lateral or dorsal spines. Palpus as figured, the details of the tibial apophysis distinctive for the species which is closely related to *Clubiona abbotti* Koch.

TYPE LOCALITY.—Male holotype from Cameron County, Texas, May 1–2, 1936 (L. I. Davis).

### Oonopidae

#### *Opopaea meditata*, new species

Figures 25 and 26

FEMALE.—Total length, 1.65 mm. Carapace, 0.70 mm. long, 0.55 mm. wide. Abdomen 0.95 mm. long, 0.64 mm. wide.

Carapace bright orange-brown, somewhat darkened on the sides, clothed sparsely with inconspicuous erect black hairs. Eyes narrowly ringed with black. Clypeal margin with seven black hairs which overlap the chelicerae. Mouth parts, sternum and legs nearly concolorous with the carapace, the appendages a little paler distally, the clothing of the legs and underside a few black hairs. Abdominal plates concolorous with the carapace, the soft parts of the abdomen gray to white, all sparsely set with inconspicuous short black hairs.

Carapace longer than broad, rather strongly convex, the pars thoracica suborbicular, the head portion weakly rounded in front, moderately constricted at its juncture with the cephalic portion. Width of the head at the posterior lateral eyes less than half the greatest width of the carapace (27/64). Carapace as viewed from the side convex and highest immediately behind the eyes, about equal in height to the position of the obsolete cervical groove, and then abruptly declining to the caudal margin. Clypeus sloping, equal in width to the short diameter of the oval anterior lateral eyes. Eyes six, the first row of two narrower than the second (15/20), the eyes separated by about their short diameter, forming a strongly procurved line with the posterior medians with which they are subcontiguous. Eyes of the second row rather strongly recurved, a line through the centers of the posterior laterals touching the caudal margins of the medians. Posterior median eyes contiguous, slightly separated from the slightly smaller posterior lateral eyes. Sternum longer than broad (40/36), truncated behind where the coxae are separated by more than their length (16/26). Labium half as high as broad, subquadrangular, nearly half as high as the convergent endites. Legs without spines. First leg: femur, 0.50 mm., patella 0.25 mm., tibia, 0.36 mm., metatarsus, 0.32 mm., and tarsus, 0.17 mm. long. Tibia and patella of the fourth leg, 0.70 mm. long. Dorsal sclerite a long oval completely covering the dorsum of the abdomen. Ventral sclerite (Figure 26) less extensive, not fully covering the venter. Spinnerets ringed with a narrow sclerite. Epigynal region as illustrated.

TYPE LOCALITY.—Female holotype from San Antonio, Texas, December 28, 1935 (L. I. Davis).

This species is distinct from *Opopaea devia* Gertsch in the eye relations, in the much higher, more convex carapace and in the details of the epigynal area.

**Stenoonops (?) juvenilis, new species****Figure 27**

MALE.—Total length, 1.10 mm. Carapace, 0.55 mm. long, 0.44 mm. wide.

Carapace bright yellow, the clothing consisting of a few scattered erect black hairs, the clypeal margin with six which are more robust. Eyes narrowly ringed with black and enclosing a black field. Sternum, mouth parts, coxae and legs uniform dull yellow, sparsely but evenly clothed with inconspicuous black hairs. Abdomen dull white to gray, clothed with black hairs.

Carapace longer than broad, evenly convex, suboval in outline, the pars cephalica at the second eye row half as wide as the greatest width. Clypeus truncated, about equal in height to the diameter of an eye of the first row. Carapace as seen from the side gently convex, nearly equal in height from the eyes to the posterior declivity, which is rather abrupt. Eyes of the first row narrower than the second (11/16), very slightly separated. Second row of eyes procurved, about equal in size and subcontiguous. Quadangle of the posterior median and the anterior eyes broader than long (11/10), wider in front (11/8). Sternum longer than broad (36/33), truncated behind, the posterior coxae separated by their length. Labium as long as broad, two-thirds as high as the endites. Legs without spines, the first patella and tibia, 0.40 mm. long. Abdomen two-thirds as broad as long. Palpus not fully developed.

TYPE LOCALITY.—Immature male holotype from Cameron County, Texas, January to March, 1936 (L. I. Davis).

This interesting species presents differences from other species of *Stenoonops* which may not admit its being included in the genus. The pars cephalica is much broader and the second eye row is distinctly procurved. The eye arrangement is much as in *Scaphiella* but the species lacks the sclerotized shields on the abdomen.



# AMERICAN MUSEUM NOVITATES

Number 882

THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

October 9, 1936

## NEW NEOTROPICAL SYRPHIDAE (DIPTERA)

By C. H. CURRAN

The following pages contain descriptions of a number of undescribed Syrphidae that have come to hand during the past few years. The types are in The American Museum of Natural History.

### MICRODON MEIGEN

Because of the difficulty in preparing a key to the species of *Microdon* from descriptions, the following table includes only those represented in the Museum Collection. The number of Neotropical species belonging to this genus must be large. It is worthy of note that very few of the described species are known from more than one or two specimens. The larvae live in the nests of ants and termites and some of them are of peculiar form. The North American *M. fulgens* Wiedemann has been included in the key because of its close relationship to a number of the species occurring in Brazil.

### TABLE OF SOUTH AMERICAN SPECIES

- 1.—Scutellum with a pair of distinct spines or very deeply emarginate and with two produced angulate projections.....13.  
Scutellum without spines, even though somewhat deeply emarginate.....2.
- 2.—Scutellum at most shallowly emarginate, the lobes not submammiform in shape.....3.  
Scutellum deeply emarginate, the lobes submammiform... *panamensis* Curran.
- 3.—Second abdominal segment wider than the first and third.....7.  
Second abdominal segment usually narrower than the first and third, or of equal width.....4.
- 4.—Mesonotum with three metallic pilose vittae..... *trivittatum* Curran.  
Mesonotum not vittate.....5.
- 5.—Antennae longer than the face.....6.  
Antennae shorter than the face..... *flukei*, n. sp.
- 6.—Face black in ground color..... *hermetia*, n. sp.  
Face yellowish in ground color..... *beebei*, n. sp.
- 7.—Wholly metallic bluish to violaceous (Chile)..... *violaceus* Macquart.  
Differently colored.....8.
- 8.—Wings with one or more yellowish or creamy fasciae (Brazil).  
*mirabilis* Williston.
- Wings without pale cross-band.....9.

- 9.—Abdomen strongly narrowed beyond the second segment.....10.  
 Abdomen at most only slightly narrowed behind the second segment.....12.
- 10.—Thorax black and brown.....11.  
 Pleura yellowish.....*lanei*, n. sp.
- 11.—Abdomen rusty reddish yellow (Panama).....*apicula* Curran.  
 Abdomen black and brownish (British Guiana).....*inarmatus* Curran.
- 12.—Face strongly carinate (British Guiana).....*carinifacies* Curran.  
 Face evenly convex (Brazil).....*willistonii* Mik.
- 13.—Scutellum wholly reddish; abdomen broadly pale basally.....14.  
 Scutellum dark in color (at least with strong metallic green tinge).....15.
- 14.—Apex of the fourth abdominal segment black haired.....*angustus* Macquart.  
 Apex and broad sides of fourth abdominal segment with tawny hairs.  
*angustiventris* Macquart.
- 15.—Antennae longer than the face.....16.  
 Antennae conspicuously shorter than the face.....*mus*, n. sp.
- 16.—Legs wholly yellowish.....*nigrispinosus* Shannon.  
 At least the coxae brown or metallic.....17.
- 17.—Scutellum with the lower border luteous or yellowish.....18.  
 Scutellum wholly dark.....21.
- 18.—Abdomen and legs mostly blackish.....19.  
 Abdomen and legs mostly reddish.....*bidens* Fabricius.
- 19.—Wings yellow, with fuscous apex and posterior border (British Guiana).  
*flavipennis* Curran.  
 Wings differently colored.....20.
- 20.—Wings blackish with about the apical fourth pale yellowish (British Guiana).  
*normalis* Curran.  
 Wings smoky, somewhat darker on the anterior half (British Guiana).  
*langi* Curran.
- 21.—Apical cell with the apex angulate or sharply rounded.....22.  
 Apical cross-vein almost straight and only slightly recurrent (Panama).  
*solitaria* Curran.
- 22.—Scutellum partly or wholly yellowish pilose.....24.  
 Scutellum wholly black pilose.....23.
- 23.—Squamae white with brown border; thorax metallic blue or cyaneous (Brazil),  
*instabilis* Wiedemann.  
 Squamae dark brown; thorax and abdomen blackish.....*nero*, n. sp.
- 24.—Legs wholly blackish.....25.  
 At least the tibiae reddish yellow.....26.
- 25.—Mesonotum almost wholly black pilose (N. America).....*fulgens* Wiedemann.  
 Mesonotum yellowish pilose.....*barbiellinii*, n. sp.
- 26.—Femora metallic green; disc of mesonotum black-haired behind the suture.  
*marceli*, n. sp.  
 Legs reddish yellow; mesonotum wholly pale-haired (Brazil).  
*splendens* Wiedemann.

### **Microdon flukei, new species**

An elongate, slender species, the abdomen with almost parallel sides. Length, 8 mm.

**MALE.**—Head shining blackish; face with yellowish-white pile; occipital pile brassy yellowish, that on the front black except near the vertex. Face and front narrow, the front widening from the anterior fourth to the vertex, the transverse groove broad; ocelli situated a little behind the middle of the front in a small triangle. Face almost evenly convex in profile, the cheeks linear. Antennae brown, much shorter than the face, the third segment black and shorter than the basal two combined; arista brown, slightly longer than the third segment. Eyes bare.

Thorax brownish or ferruginous, the mesonotum black except on the sides and posterior border; scutellum black on the disc. Hair brassy yellow, almost white on the sternopleura, subappressed. Margin of scutellum evenly rounded.

Legs reddish, the basal half of the tibiae yellow; posterior femora broadly brown in the middle except below. Hair pale yellowish, almost white on the basal half of the tibiae; black on the posterior femora, apical third of the posterior tibiae, upper and anterior surfaces of the anterior four femora and on the apical tarsal segments.

Wings cinereous hyaline, with weak brownish clouds along the veins. Apical and posterior cross-veins transverse, gently sinuous, the end of the apical cell almost angular posteriorly. Squamae brownish gray. Halteres reddish yellow.

Abdomen blackish; second segment with the base, broad apex and middle of the dorsum reddish; third segment with the broad apex reddish, the fourth more or less reddish on the apical fifth; genitalia reddish. Pile short and black, longer and yellowish on the base of the abdomen and on the reddish apices of the second and following segments, on the sides of the segments apically almost white. Venter with the intermediate segments reddish and with yellow pile, the pile otherwise black; genitalia with black hair.

**Types.**—Holotype, male, and paratype, male, Petropolis, Brazil, November, 1929.

### ***Microdon hermetia*, new species**

Black, the second abdominal segment with translucent yellow spots; wings brown on the anterior third. Length, 16 mm.

**MALE.**—Head black, the face brownish with darker borders. Front narrow, strongly widening anteriorly and moderately widening to the vertex, the transverse depression broad, situated a little in front of the middle; ocellar triangle small, situated in the middle of the upper portion of the front; pile black, a band of white hairs across the depression and a patch at each side of the vertex. Occiput with thin whitish pollen above and below and with pale yellowish pile, the middle portion with black hair. Cheeks moderately wide. Face produced somewhat downward and only slightly convex; pile subappressed, white, the middle with black pile on the lower half ending in a nasal patch; cheeks bare in front. Antennae elongate, the third segment as long as the basal two combined, the second one-fourth as long as the first; hair black; arista brown, three-fourths as long as the third segment. Upper portion of the front thinly whitish pollinose. Eyes with short, sparse hair.

Thorax black, the pleura and a spot inside each humerus thinly white pollinose; hair short and black, a prescutellar band and patches inside the humeri rather silvery white; pleura and scutellum with white hair. Scutellum short and convex.

Legs black; tibiae brown, the tarsi becoming reddish apically; hair yellowish on the femora, some black hairs basally on the upper surface, white on the tibiae and tarsi.



Wings broadly brown in front, hyaline posteriorly; bend of fourth and fifth veins very broadly rounded. Squamae whitish with brown fringe. Halteres yellow with brown knob.

Abdomen elongate, the sides of the basal two segments parallel, the third slightly wider than the widened apex of the second; black, with the apex and genitalia brownish red; second segment with a pair of oblique, subtriangular, translucent yellow spots. Hair black, pale yellowish on the sides and on more than the apical half of the fourth segment; a band of short, dense whitish pile on the apex of the first segment. Venter brownish black, the second sternite translucent yellow, the third with a reddish apex; pile yellowish white, mostly black on the third sternite. Genitalia produced posteriorly on the right and bearing black hair.

HOLOTYPE.—Male, Barro Colorado Island, Canal Zone, December 23, 1928 (Curran).

In shape and color this species bears a strong superficial resemblance to some species of *Hermetia*.

#### ***Microdon beebei*, new species**

Black, with yellow markings; abdomen elongate and clavate; legs reddish. Length, 18 mm.

FEMALE.—Head rather badly damaged; front black with strong metallic green reflections and with appressed golden pile on at least the lower half. Occiput black, thinly pale pollinose, the pile apparently yellowish. Cheeks black, with yellow pile posteriorly. Face yellowish, moderately convex in profile, with appressed golden-yellow pile, the middle with some short black hairs. Antennae with the basal segment more than half as long as the face, black with almost the basal half reddish. Eyes bare.

Thorax black with metallic blue reflections, the humeri yellowish. Mesonotum with the sides, a broad prescutellar fascia and a geminate fascia extending across in front of the suture, its anterior band produced broadly forward in the middle, golden pilose, the remaining pile short and black. Scutellum metallic blue, its pile golden and appressed. Pleura with a broad band of golden-yellow pile extending downward in front of the wings and becoming whitish on the sternopleura.

Legs reddish; coxae black or brown; tibiae yellow on basal half or more; pile yellowish, appressed; posterior femora with short black spines on the apical half of the ventral surface.

Wings cinereous hyaline, the longitudinal veins on the apical half of the middle of the wing bordered with yellowish brown. Squamae white, with yellow border. Halteres reddish.

Abdomen brown with yellow markings, the first segment mostly metallic bluish above. Second segment long and narrow, as long as the third and fourth combined, narrowest near its apex, the apical three segments forming an oval club. Second segment with a pair of broad yellowish vittae extending the whole length, the third yellow with a median brown vitta on the basal three-fourths. Pile short and black; golden yellow on the first segment and broad apices of the second to fourth, on the anterior angles of the third and the whole of the fifth segment. Venter brown, the second and third sternites mostly yellow.

HOLOTYPE.—Female, Kartabo, British Guiana, October 8, 1921 (Wm. Beebe).

Because of the damaged condition of the head I have hesitated to describe this species. However, it is so very distinct from any of the known forms that there should be no difficulty in recognizing it, despite the incomplete description of the front and antennae.

***Microdon lanei*, new species**

A small, ferruginous yellowish species, the mesonotum with three very broad brownish vittae. Length, about 9 mm.

**FEMALE.**—Head rusty yellowish, the front somewhat darker. Front about twice as long as wide, the sides gently diverging on the anterior half; pile short, black; depression very weak; ocelli situated near the middle of the upper section, the triangle small; a brown spot covers the ocellar triangle. Occiput and face yellow pilose, the cheeks linear. Face narrowest below, very gently convex on the upper three-fourths. Antennae reddish brown, the basal segment black, about as long as the face, the third segment as long as the basal two combined; arista not as long as third segment. Eyes with inconspicuous sparse hairs.

Mesonotum with three very broad brown vittae, leaving a pair of posteriorly tapering yellow vittae dorsocentrally. Pile yellowish, black on the black vittae and scutellum.

Legs reddish yellow; wholly pale pilose.

Wings with luteous tinge; apical cross-vein recurrent, almost straight. Squamae with black border and fringe. Halteres reddish.

Adbomen strongly constricted and somewhat laterally compressed beyond the second segment; pale pilose except on the broad base of the second segment, the pile very short.

**HOLOTYPE.**—Female, Jaquía, São Paulo, Brazil, November, 1929 (J. Lane), received from Dr. C. L. Fluke.

***Microdon mus*, new species**

A small, moderately slender species; brownish and reddish, the abdomen widest at the apex of the second segment; scutellar spines long, approximate. Length, 7.5 mm.

**MALE.**—Head brown, the face luteous; pile yellowish, black on the lower section of the front. Front narrow, narrowest at the anterior third, the depression moderately strong; ocelli situated on the middle of the upper section. Face very gently convex, not strongly receding below, the pile moderately long. Antennae brownish red, shorter than the face, the third segment about as long as the basal two combined; arista not as long as the third segment. Eyes bare.

Thorax brownish red, the mesonotum black with the lateral and posterior margins reddish; pectus mostly brown or black. Pile rather dull brassy yellow. Scutellum brownish red, subtriangular in shape, with a pair of strong, approximate apical spines, the pile black except on the basal corners.

Legs reddish, the femora black or brown, with the apices broadly reddish; pile yellowish, white on the tibiae.

Wings cinereous, the veins narrowly bordered with brown, particularly those on the apical half of the wing; apical cross-vein recurrent, gently curved, the bend of

the fourth vein with an appendage. Squamae whitish, with yellow border and white fringe. Halteres yellow.

Abdomen brown, the sides and apices of the segments broadly reddish, the fourth segment mostly reddish brown. Pile black, yellowish white on the base, sides and broad apex; on the third and fourth segments extending triangularly inward at the base; on the apical fourth of the third segment the pale pile forms a broadly interrupted fascia; on the fifth it is in the form of large apical triangles that extend forward almost to the middle of the segment and are separated by a V-shaped wedge of black pile. Genitalia reddish. Venter mostly reddish, the pile wholly pale.

HOLOTYPE.—Male, Jaquia, São Paulo, Brazil, November, 1929 (J. Lane), received from Dr. C. L. Fluke.

#### *Microdon nero*, new species

Black; pile mostly black, partly golden yellow on head, thorax and abdomen. A robust species, the scutellum subrectangular. Length, 12 mm.

MALE.—Head black, the face and occiput with yellow pile, the occiput pale pollinose, with black hair on each side of the vertex. Front very narrow at the anterior third, moderately widening above and below, the depression strong; pile wholly black; ocellar triangle situated near the middle of the upper section. Cheeks moderately narrow, thinly gray pollinose and black pilose. Face shining, the sides subparallel, in profile strongly convex below, scarcely convex on upper third, thickly golden-yellow pilose, with a slender, bare median vitta and a few black hairs below the base of the antennae. Antennae with the first segment black, elongate, the others missing. Eyes with inconspicuous black pile.

Thorax black, the pleura in part brown; pile black, short and rather thick; mesonotum with appressed golden-yellow pile in front of the suture. Apex of scutellum concave, the widely separated spines strong.

Legs wholly black, with short, appressed black hair.

Wings brown, pale in the basal cells; apical cell angular apically. Squamae and knob of halteres black.

Abdomen shining black, with short, appressed black hair; a pair of broad, golden-yellow pilose vittae extend from the base of the third segment to the end of the abdomen but are interrupted at the base of the fourth segment; the broad apex of the abdomen bears similar pile and this extends forward inside the lateral margins and expands to form basal triangles on the fourth segment. Hair on genitalia and venter wholly black. The abdomen is widest at the apex of the second segment where it is considerably wider than the thorax.

HOLOTYPE.—Male, São Paulo, Brazil (Count A. A. Barbiellini).

#### *Microdon barbiellini*, new species

Metallic blue, green and violaceous, the legs wholly black; scutellum subrectangular. Length, 8.5 mm.

MALE.—Head violaceous, pale yellow pilose, the front with black pile. Front narrow, strongly widening in front of and behind the depression which lies at the anterior third, the ocellar triangle situated at the middle of the upper section. Occiput mostly metallic green, thinly pollinose along the lower orbits. Cheeks moderately narrow. Face gently convex, more strongly so below, with subparallel sides. Antennae black, longer than the face, the first segment almost as long as the second

and third combined; arista shorter than the third segment. Eyes with very short, sparse black or brown pile.

Thorax violaceous, the pleura and scutellum largely blue; pile yellowish dorsally, black on the pleura; a weak, incomplete band of black hairs between the roots of the wings. Apex of scutellum transverse, the widely separated spines of medium size.

Legs black, the coxae and femora more or less violaceous, the pile wholly black.

Wings grayish; apical cell with the apex triangularly produced. Squamae whitish, with golden-yellow fringe. Halteres reddish yellow.

Abdomen metallic green; above with short, appressed black hair, on the base, sides and apex with longer, thick, subappressed yellowish pile; apex of the fourth segment more or less reddish, the genitalia wholly reddish. Venter violaceous with the apices of the segments reddish yellow, the pile black.

**HOLOTYPE**.—Male, São Paulo, Brazil, May, 1924 (Count A. A. Barbiellini), received from Dr. C. L. Fluke.

#### ***Microdon marceli*, new species**

Metallic green, the head and thorax sometimes blue; tibiae and tarsi yellow; scutellum subrectangular. Length, 8 to 10 mm.

**MALE**.—Head metallic green, the front sometimes bluish, the occiput grayish pollinose. Front narrow, widening anteriorly and posteriorly, the depression rather deep; pile black; ocelli situated slightly behind the middle of the upper section. Pile of the occiput and face pale yellowish. Face gently convex, more strongly so on the lower half, widest below. Antennae black, elongate, the first and third segments of equal length, the second one-fourth as long; arista shorter than the third segment. Eyes with inconspicuous sparse hairs.

Thorax sometimes quite bluish or violaceous above pale yellowish pilose the disc of the mesonotum black pilose behind the suture; scutellar pile all pale, the apex of the scutellum transverse, the spines strong.

Coxae and femora green; apices of the femora, the tibiae and tarsi reddish yellow; pile wholly yellowish.

Wings with pale brown tinge; apex of apical cell angularly produced. Squamae and halteres yellowish.

Abdomen with short appressed black pile dorsally, the first two segments, lateral margins and a large triangle covering the apical third of the fourth segment with longer, yellow pile, the pale pile expanding on the fourth segment to form a longitudinal basal triangle on each side. Genitalia and ventral incisures reddish yellow, the apex of the fourth segment sometimes partly reddish. Venter green, the pile wholly pale.

**TYPES**.—Holotype, male, and allotype, female, Chapada, Brazil (Williston collection).

Named in honor of Marcel Barbiellini, a constant companion of Count Barbiellini on his collecting trips in the vicinity of São Paulo.

#### **VOLUCELLA GEOFFROY**

Since it is necessary to describe a number of species in which the scutellum bears one or more depressed areas a revised key to this section of the genus is presented.

## TABLE OF SPECIES HAVING SCUTELLAR DEPRESSIONS

- 1.—Scutellum with preapical depression.....2.
- Scutellum differently shaped, flattened to strongly convex.....26.<sup>1</sup>
- 2.—Face metallic green.....3.
- Face not metallic green.....6.
- 3.—Eyes with dense, short, thickened white pile; cheeks with yellow triangle;  
tarsi reddish.....*viridis* Williston.
- Eyes with normal cinereous pile; tarsi blackish.....4.
- 4.—Cheeks wholly green; mesonotum wholly yellow-haired.....*ernesta* Curran.
- Cheeks with reddish or yellowish vitta in front.....5.
- 5.—Fourth abdominal segment black pilose.....*viridana* Townsend.
- Fourth abdominal segment yellowish or tawny pilose.....*ernestina* Curran.
- 6.—Bristles of the thorax yellow.....7.
- Bristles of the thorax black.....17.
- 7.—Wings with sharply defined, triangular, apical brown spot.  
*tympaenitis* Fabricius.
- Wings without sharply defined apical spot.....8.
- 8.—Squamae brown or with brown border.....9.
- Squamae yellowish.....*pallens* Wiedemann.
- 9.—Mesonotum wholly pale pilose on posterior half.....10.
- Mesonotum broadly black pilose in front of scutellum.....13.
- 10.—Disc of scutellum with coarse black hairs.....*vaga* Wiedemann.
- Disc of scutellum with pale hairs only.....11.
- 11.—Cheeks and face separated by a very broad brownish vitta.....12.
- No brown vitta separating face and cheeks.....*brevifacies* Curran.
- 12.—Mesonotum with the median third black; black vitta separating face and  
cheeks very wide and of uniform width.....*chapadensis* Curran.
- Mesonotum usually all ferruginous on the disc (if with black vitta it is partly  
linear); vitta separating face and cheeks usually narrow, sometimes broad  
above.....*bequaerti*, n. sp.
- 13.—Broad sides of mesonotum yellow pilose on whole length....*brevivittata* Curran.
- Mesonotum black pilose on full width posteriorly.....14.
- 14.—Tibiae much darker than the femora.....15.
- Tibiae and femora orange, the tibiae not darkened but with black pile.  
*flupei*, n. sp.
- 15.—Fourth abdominal segment wholly black-haired.....16.
- Fourth abdominal segment with yellow pile on basal half....*musicana* Curran.
- 16.—Ventral scutellar fringe yellow.....*lanei*, n. sp.
- Ventral scutellar fringe black.....*mocana*, n. sp.
- 17.—Scutellum without lateral flattened or depressed roughened areas.....18.
- Scutellum with lateral flattened or depressed roughened areas.....27.
- 18.—Squamae, or at least the border and fringe, brown or black.....20.
- Squamae and fringe yellowish or reddish.....19.
- 19.—Mesonotum wholly pale.....*punctifera* Bigot.
- Mesonotum broadly black in front and in the middle....*corumbensis* Curran.
- 20.—Face wholly black or with a median brown or black stripe.....22.

<sup>1</sup> See key, Bull. A. M. N. H., LXVI, p. 379, 1934.

- Face without a median dark vitta; legs brown, the basal segment of the posterior tarsi reddish; cheeks with a slender vitta; face produced strongly downward as a narrow cone; thorax rusty brown, the mesonotum violaceous on the disc; scutellum wholly black pilose.....21.
- 21.—Eyes black pilose.....*johnsoni* Curran.  
Eyes white pilose.....*salti* Curran.
- 22.—Legs wholly black.....23.  
Coxae yellow or the legs otherwise pale.....24.
- 23.—Sides of face very broadly yellow.....*vierecki* Curran.  
Face black with a narrow whitish pollinose stripe on either side below.  
*cinctiventris* Curran.
- 24.—Thorax wholly pale, the dorsum black-haired; scutellum with large, roundish black spot covering most of its surface.....*discalis* Curran.  
Thorax largely dark or practically all pale-haired; scutellum differently colored.....25.
- 25.—Scutellum with yellow base and apex; facial vitta broad and reaching the antennae; front of female usually pale except above.....26.  
Scutellum wholly violaceous; facial vitta narrow, not nearly reaching base of antennae; front black.....*fracta* Curran.
- 26.—Pteropleura black-haired; mesonotum narrowly yellow behind the suture.  
*musana* Curran.  
Pleura wholly yellow pilose; mesonotum very broadly yellow behind the suture.....*mus* Williston.
- 27.—Lateral depressions on scutellum as long as wide.....*tricincta* Bigot.  
Lateral depressions on scutellum decidedly transverse.....28.
- 28.—Fourth abdominal segment entirely pale; ferruginous species with narrow black apices to the abdominal segments.....*chalybescens* Wiedemann.  
Fourth segment black or the apical three segments almost unicolorous....29.
- 29.—Fourth abdominal segment wholly white pilose.....30.  
Fourth abdominal segment white pilose only on the broad sides and extreme apex.....*salti* Curran.
- 30.—Front of both sexes black or brown.....*deceptor* Curran.  
Front yellowish.....*apicalis* Loew.

### *Volucella bequaerti*, new species

A rather small yellowish-green or rusty reddish-yellow species, the disc of the mesonotum ferruginous; scutellum with deep, black preapical depression. Length, 6 to 9 mm.

FEMALE.—Head greenish yellow or pale rusty reddish yellow, the pile short, sparse and yellowish; a few black hairs at the vertex; posterior orbits cinereous pollinose, the occiput black in ground color except below. Front narrow above, moderately widening anteriorly, the ocellar triangle small. Face moderately produced downward, separated from the cheeks by a black or brown stripe that may be wide above; usually a brown spot below the eyes. Face deeply concave above, with a moderately prominent tubercle below. Antennae pale orange, the third segment broad basally, gently tapering to the rounded apex; arista, mostly black, with long black rays above and below.

Thorax shining yellowish or greenish yellow, the disc of the mesonotum pale ferruginous; mesonotum sometimes with a black prescutellar spot in the middle and a black spot on the anterior border, these sometimes connected by a black line; posterior half of the pectus sometimes mostly black. Pile and bristles yellow, the former short. Scutellum with the deep preapical depression black or brown in color.

Legs reddish or greenish yellow, the tibiae and tarsi black or brown and black-haired; basal tarsal segment somewhat reddish; femora yellow-haired.

Wings hyaline basally, pale brownish on the apical half; stigma luteous, with brown basal spot.

Abdomen greenish or reddish yellow, the apices of the segments black except on the sides. The apical two or three segments are frequently stained in drying and may appear brownish, but the black fasciae are always distinct. Hair black on the dorsum, short and appressed, yellow on the two basal segments except on the broad apex of the second. Venter wholly pale.

**Types.**—Holotype, female, Moca, Guatallon, Guatemala, about 3000 ft., March, April, 1931 (J. Bequaert). Paratypes: two females, same data; three females, Santa Emilia, Pochuta, Guatemala, about 3000 ft., February, March, 1931 (J. Bequaert); female, Chiapas, Mexico, 2500–3000 ft., 1919 (L. Hotson); female, Cayuga, Guatemala, June, 1915 (Wm. Schaus).

*V. bequaerti* is very similar to *chapadensis* Curran but the face is narrower and a little more produced downward.

#### *Volucella flukei*, new species

Yellowish green; abdominal incisures bordered with brown; wings grayish on the apical half. Length, 10 mm.

**FEMALE.**—Head yellowish red, the face and front with strong green tinge; occiput mostly black in ground color. Front narrow, its sides gently diverging anteriorly; hair black, sparse. Posterior orbits white pollinose and yellow pilose. Cheeks separated from the face by a rather narrow brown line and with a short brown stripe below the eye. Face with yellow pile, deeply concave above, the tubercle prominent. Antennae orange, the third segment slightly tapering to the rounded apex; arista with black rays and apex. Eyes with black pile.

Thorax yellowish red, the dorsum rather greenish, the disc of the mesonotum more or less ferruginous, but the dark color does not reach the scutellum. Pile reddish yellow, black on the dorsum except on the sides in front of the wings, not abundant. Scutellum with yellowish bristles and black hair, the deep preapical depression black.

Legs reddish, the tibiae and tarsi with black hair, the apical two or three tarsal segments brown or black.

Wings hyaline, the apical half grayish, somewhat brownish along the veins; stigma luteous, with small black basal spot.

Abdomen yellowish green basally, the apical three segments rather brownish green, the incisures broadly brown. It is probable that many specimens will have the apical segments only slightly darker than the base of the abdomen, as there is frequently a considerable darkening due to the abdominal contents adhering to the upper integument after death. Pile black, yellow on the pale base and basal half of the venter; venter rusty reddish.

**HOLOTYPE.**—Female, Paraná, Brazil, received from Dr. C. L. Fluke.

*Volucella lanei*, new species

Similar to *flukeyi*, new species, but with brown tibiae and tarsi and yellow ventral scutellar fringe. Length, 9 mm.

**MALE.**—Head yellowish red, the face and front with strong green tinge; occiput mostly black. Frontal triangle small, pale yellowish pilose; vertical triangle brown, pale pilose, a few black hairs at the vertex and along the upper posterior orbits. Posterior orbits whitish pollinose and dull yellowish pilose. Cheeks separated from the face by a broad brown stripe; a rectangular brown spot below the eyes. Face deeply concave above, the tubercle moderately prominent; pile sparse, wholly pale. Antennae reddish yellow; third segment narrowed from base to middle, the apical half with almost parallel sides; arista with long brown rays. Eyes luteous pilose.

Thorax yellowish, the dorsum pale greenish, the disc of the mesonotum ferruginous except for a moderately wide prescutellar band; pectus black on the posterior half. Pile pale yellowish, black on the posterior fourth of the mesonotum and on the scutellum; bristles yellowish. Preapical scutellar depression deep and black in color, the ventral fringe yellow.

Legs reddish, the tibiae and tarsi reddish brown to brown, black pilose, the femora with yellowish pile except on the apices; tarsi becoming black apically.

Wings hyaline, the apical half tinged with brown; a basal spot in the stigmal cell, and small clouds on the furcation of the third vein and the anterior cross-vein brown. Squamae brown, white basally.

Abdomen greenish yellow (apple-green in life), the incisures broadly bordered with brown on the dorsum. Hair black, yellow basally and on the venter. Genitalia brown and brownish red, the apical sternites more or less brown.

**FEMALE.**—Front and face more evidently greenish and with black hairs on the upper half; mesonotum with a pair of incomplete, dark ferruginous vittae in the middle, lying on the pale ferruginous portion.

**TYPES.**—Holotype, male, Jaquia, São Paulo, Brazil, November, 1929 (J. Lane). Allotype, female, São Paulo, June 15, 1931 (H. Guradis). Received from Dr. C. L. Fluke, to whom the allotype has been returned.

*Volucella mocana*, new species

Related to the preceding species but the pile of the scutellum is wholly black and there is a suborbicular black spot on the mesonotum immediately in front of the scutellum. Length, 9 mm.

**FEMALE.**—Head reddish yellow, the occiput mostly black in ground color. Front with the sides gradually diverging from the vertex to the level of the antennae; pile black, yellow on the anterior fifth; ocellar triangle brown. Posterior orbits whitish pollinose and with yellowish pile. Cheeks separated from the face by a brown stripe, and with a brown spot below each eye. Face deeply concave above, the tubercle moderately prominent; hair wholly pale. Antennae reddish yellow; third segment gently tapering to the obtusely rounded apex; arista with long black hair. Eyes with rather sparse black pile.

Thorax reddish yellow, the dorsum shining; disc of mesonotum pale ferruginous; a small round black spot in the middle immediately in front of the scutellum. Pile yellowish, black on the scutellum and posterior fourth of the mesonotum. Pectus little darker than the pleura.



Legs reddish, the tibiae and tarsi black or brown, the basal tarsal segment more or less reddish. Pile yellow, black on the tibiae and tarsi.

Wings hyaline, grayish or luteous on the apical half; stigma with brown basal spot. Squamae brownish, with yellowish base.

Abdomen reddish yellow, with slight greenish tinge, the incisures bordered with black. Hair black, appressed, yellow on the base and venter. Venter wholly pale.

Types.—Holotype, female, Moca Guatallon, Guatemala, 3000 ft., March, April, 1931 (J. Bequaert). Paratypes: female, same data, and female, Pochuta, Guatemala, 3000 ft., February, March, 1931 (J. Bequaert).

#### ALLOGRAPTA OSTEN SACKEN

The following key separates the known American species belonging to this genus.

#### TABLE OF SPECIES

- 1.—Pteropleura black except just below the wing base.....4.  
Pteropleura crossed by a yellow spot connecting the metapleural and sternopleural spots.....2.
- 2.—Oral margin strongly produced.....species incerta.  
Oral margin not produced.....3.
- 3.—Face with a sharply defined black vitta (Galapagos).....*splendens* Thomson.  
Face at most obscurely brownish in the middle.....*obliqua* Say.
- 4.—Disc of scutellum with a sharply defined large, posteriorly convex, black or dark brown spot.....13.  
Disc of scutellum with at most a rusty reddish spot.....5.
- 5.—Metapleura with a pale yellow spot.....7.  
Metapleura wholly dark in color.....6.
- 6.—Fifth abdominal segment with four yellow spots.....*micrura* Osten Sacken.  
Fifth abdominal segment with arched fascia (Peru, Colombia).  
*Fazia fasciata* Curran.
- 7.—Oral margin considerably more prominent than the antennal base.....8.  
Oral margin at most slightly more prominent than the antennal base.....9.
- 8.—Fifth abdominal segment with four yellow spots.....*picticauda* Bigot.  
Fifth abdominal segment with broad yellowish fascia.....*fluvi*, n. sp.
- 9.—Cheeks with a black or brown band across the middle.....10.  
Cheeks wholly yellow.....*pulchra* Shannon.
- 10.—Fourth abdominal segment with a geminate median yellow vitta.....12.  
Fourth abdominal segment with pair of spots.....11.
- 11.—Pale spots on the fourth abdominal segment strongly oblique (Chile).  
*hortensis* Philippi.  
Pale spots on fourth segment almost parallel (Peru).....*piurana* Shannon.
- 12.—Mesonotum wholly shining.....*exotica* Wiedemann.  
Mesonotum with four opaque brownish vittae (S. America)...*neotropica*, n. sp.
- 13.—Anterior oral margin much more prominent than the antennal base.....14.  
Anterior oral margin not or only slightly more prominent than the antennal base.....16.
- 14.—Hair of the anterior tibiae mostly yellowish.....15.

- Hair of the anterior tibiae all black.....*colombia* Curran.
- 15.—Disc of mesonotum unicolorous; fourth segment with vittae...*similis* Curran.  
Disc of mesonotum with four darker vittae; fourth abdominal segment without  
vittae.....*alta*, n. sp.
- 16.—Squamae brown except at base; front of male black pilose.  
*fuscisquama* Curran.
- Squamae at most slightly infuscated; front of male almost all yellow pilose..17.
- 17.—Black median spots on the bases of the third and fourth abdominal segments  
triangular in outline.....*venusta* Curran.
- These spots almost orbicular, a little longer than wide.....*cubana* Curran.

### **Fazia fasciata Curran**

*Allograpta fasciata* CURRAN, 1932, Amer. Mus. Novit., No. 519, p. 4.

Despite the narrow abdomen I now feel that this species, described in *Allograpta*, should be placed in *Fazia* Shannon, because of the very widely separated antennae. In *fasciata* the antennae are more widely separated than in any of the other species now placed in *Fazia*. This genus is actually close to *Epistrophe* Walker, the only important difference being the distance separating the antennae. In *grossulariae* Meigen, the type of *Epistrophe*, the antennal pits are only narrowly separated whereas in *F. bullaephora* Shannon the pits are conspicuously separated. A study of a large amount of material from the Neotropical region will be necessary before any definite conclusions can be drawn in regard to the generic limits. This may result in the union of *Fazia* and *Epistrophe*, with the transfer to the same group of those species of *Allograpta* in which the face is produced, and the resurrection of *Stenosyrphus* Matsumura for almost all the species now placed in *Epistrophe*.

### **Allograpta flukei, new species**

Oral margin produced; face with shining black vitta; abdomen yellow fasciate. Length, 11 mm.

MALE.—Frontal triangle bronze-black with the orbits very broadly orange, opaque or subopaque except anteriorly; pile black. Vertical triangle and occiput black in ground color, the latter cinereous pollinose; pile of the vertical triangle black, of the occiput yellow on the upper part and white on the lower two-thirds. Cheeks yellow with a large black spot below the eyes. Face strongly produced forward, the anterior oral margin lying well above the lower edge of the eyes; shining orange-yellow in color with a broad shining black median vitta extending over the whole length; tubercle strong but not more prominent than the oral margin; pile yellow, black above. Antennae brownish red, the third segment black on the upper half except at the base; arista black.

Thorax shining greenish black, the disc of the mesonotum bronzed and dull, with yellow markings as follows: the humeri, notopleura and posterior calli, a large spot on the posterior of the mesopleura and a spot on the metapleura, and indications of a pale spot on the upper part of the sternopleura. Pile pale tawny, a

broad band of black hair extending across the mesonotum between the bases of the wings but not quite reaching the lateral margins. Scutellum dull reddish yellow with the base and free border narrowly black; pile black, the lower marginal fringe reddish yellow.

Legs reddish yellow, the coxae, posterior femora and all the tarsi blackish, the posterior tibiae black with broad basal and median bands of reddish brown. Pile black, yellow posteriorly on about the basal half of the femora and on the whole posterior surface of the anterior tibiae. Middle femora brown on the basal half of the ventral surface.

Wings strongly tinged with brown, paler on the basal third. Squamae grayish white with brownish yellow fringe. Halteres reddish yellow.

First abdominal segment shining black with the sides very broadly yellow; second segment opaque black, with the margins shining, across the middle with a broadly interrupted dull yellow fascia, the outer ends of the spots truncate and conspicuously wider than the rounded inner ends; third segment similar but the spots are broadly united, forming an arched yellow band, the outer ends of the fascia convex in front. Fourth segment similar to the third but with the pale fascia somewhat more strongly arched and the segment mostly shining behind the yellow band. Fifth segment reddish yellow with the anterior corners and the broad apex shining black. Pile black; yellow on the first segment, basal two-thirds of the second and on the yellow fascia on the third except in the middle. Genitalia shining black. Venter reddish yellow, the pile wholly pale.

**HOLOTYPE**.—Male, Loma del Gato, Sierra del Cobre, Oriente, Cuba, September 24–30, 1935, 2600–3325 ft. (J. Acuna, S. C. Bruner, L. C. Scaramuzza), received from Dr. C. L. Fluke.

### *Allograpta neotropica*, new species

Face with median black vitta; fourth abdominal segment with geminate median yellow stripe. Length, 8 to 9 mm.

**MALE**.—Frontal triangle dull, shining immediately above the antennae, black with the orbits broadly yellow; pile black. Vertical triangle dull blackish, black-haired. Occiput cinereous pollinose, yellow pilose above, white on the lower half or more. Cheeks yellow behind, black in front. Face yellow with a broad, median shining black vitta that narrows strongly below the tubercle; oral margin scarcely more prominent than the antennal base; tubercle long and low, the face concave above but convex immediately below the antennae; pile pale yellow except on the upper corners. Antennae reddish, the third segment black on about the upper half, the basal segments brown above.

Thorax shining blackish green; mesonotum dulled and with four opaque dark vittae that unite immediately before the scutellum; with yellow markings as follows: a broad stripe extending from the humeri to the suture, the posterior border of the mesopleura, the upper border of the sternopleura, a large spot on the metapleura and the posterior calli. Pile tawny. Scutellum dull yellow, the disc with a more or less distinct rust-colored spot; pile, including the ventral fringe, black.

Legs reddish yellow; coxae brown; posterior femora with the apical half or slightly more black, the apex reddish; posterior tibiae black with broad basal and median bands of reddish; tarsi all blackish. Pile black, yellow on the anterior surface of the tibiae and each femur with a few pale hairs basally.

Wings cinereous hyaline. Squamae yellow with the inner third and upper lobe brown. Halteres reddish yellow.

First abdominal segment yellow with a transverse blackish spot toward either side. Second segment dull black with the anterior fourth and broad apex somewhat shining, across the middle with a broadly interrupted reddish yellow fascia formed by triangular spots that extend over the lateral margins in their full width. Third segment black with the base, apex and lateral margins shining; the yellow fascia is strongly arched although only gently convex in front toward the middle, its posterior border limited by the more or less triangular black portion. Fourth segment black with a pair of median yellow vittae and oblique lateral stripes, the latter broadly connected with the vittae in front, the yellow markings broadly separated from the posterior border of the segment. Fifth segment black with yellow apex and two pairs of more or less triangular yellow vittae that do not reach the posterior or lateral margins. The fasciae on the third and fourth segments are narrowly separated from the lateral margins. Pile black, yellow on the first segment, basal two-thirds of the second and on the pale fascia on the third. Genitalia shining black. Venter reddish, pale pilose.

**FEMALE.**—Front opaque black, with the anterior border and upper fifth shining; sides broadly yellow on the lower two-thirds, the upper ends of the stripes rounded; pile black. All the femora broadly pale pilose basally. First abdominal segment sometimes with only the broad sides yellow, the yellow fascia on the second segment entire although slightly constricted in the middle; fascia on the third segment narrow and of almost uniform width; markings on fourth and fifth segments almost as in the male.

**TYPES.**—Holotype, male, Popayan, Colombia, February 14, 1935 (H. F. Schwarz). Allotype, female, between Querebral and Buenaventura, Colombia, February 3, 1935 (James Aranibar). Paratypes: female, Popayan, February 14 (H. F. Schwarz); male and two females, São Paulo, Brazil, November, 1933; three females, November, 1929; and male and female, January 17, 23, 1936 (F. Lane).

#### *Allograpta alta*, new species

Face produced below, with broad median black vitta; fourth abdominal segment fasciate; wings light brownish. Length 10 mm.

**MALE.**—Frontal triangle greenish black, with the orbits very broadly dark orange, shining in front, opaque above; pile black. Vertical triangle bronze-black, black pilose. Occiput cinereous pollinose and yellow pilose, the pollen and pile becoming white on the lower half. Cheeks mostly black immediately below the eye. Face shining dark yellowish, with an entire, shining greenish-black median vitta; oral margin strongly oblique, its anterior end lying well above the lower edge of the eyes and fully as prominent as the conspicuous tubercle; pile mostly black. Antennae brown, the third segment reddish on the lower half.

Thorax shining greenish black, the pleura thinly cinereous pollinose, the mesonotum dulled and with five rather obscure darker vittae. Yellow markings as follows: a broad lateral stripe in front of the suture, posterior calli, an obscure spot posteriorly on the mesopleura, a small triangle on the pteropleura and a larger triangle above the halteres. Pile reddish yellow, some black hair on the posterior calli. Scutellum dull orange with a large, hemispherical brown spot on the disc, the pile, including the ventral fringe, black.

Legs blackish, the broad apices of the femora, basal fourth of the posterior four tibiae, the whole of the anterior pair and the apical segment of the anterior four tarsi reddish. Pile black, pale on the coxae.

Wings strongly tinged with brown. Squamae and halteres reddish yellow.

Abdomen dull black with the sides and apices of the segments shining, crossed by three reddish-yellow fasciae, the fifth segment with four spots. First segment wholly shining, the sides broadly yellowish. Pale fascia on the second segment extending across the middle, narrowly interrupted, the inner ends of the spots more or less rounded, the fascia extending over the lateral margins in almost its full width, narrow and gradually narrowing toward the middle of the segment. The fascia on the third segment is gently arched and lies almost wholly before the middle of the segment, the outer ends strongly convex in front, the base of the segment narrowly shining; in the middle with a small spur of yellow projecting posteriorly from the pale fascia. Markings of the fourth segment similar to those on the third but the yellow fascia is bidentate in the middle. Fifth segment with pair of subtriangular pale basal spots in the middle and with broad, oblique sublateral stripes that widen posteriorly, all of the spots limited to the basal two-thirds of the segment. Pile black, yellow on the first segment and anterior two-thirds of the second. Yellow fasciae on third and fourth segments well separated from the lateral margins. Venter reddish yellow and pale pilose. Genitalia shining black.

HOLOTYPE.—Male, Popayan, Colombia, February 14, 1935, 7000 to 7800 ft. (H. F. Schwarz).

#### BACCHA FABRICIUS

The following species is of more than usual interest because of its close relationship to *bigoti* Austen. It is somewhat brighter in appearance and has a larger brown cloud over the middle of the wing.

#### *Baccha lanei*, new species

Related to *bigoti* Austen but the tibiae are not whitish yellow basally. Length, 12 to 13 mm.

MALE.—Head black in ground color; face except obscurely in the middle, broad sides of the frontal triangle and the occiput cinereous-white pollinose; occipital cilia and facial pile yellow, the upper cilia and frontal and vertical pile black. Face without distinct tubercle, very gently convex below the middle. Antennae reddish yellow the third segment brown on the upper border and apex; arista brownish.

Thorax shining black, the pleura and sides of the mesonotum brownish red or rather cupreous; pile very short and black, yellowish on the mesopleura, on a large area immediately in front of the scutellum and on the scutellum, the scutellum with longer pile and with long ventral fringe.

Legs brown or reddish brown, the femora becoming reddish or reddish yellow apically; tibiae with the broad base and apex reddish yellow, the anterior four sometimes with only pale brownish bands; tarsi wholly reddish yellow. Pile on femora and posterior tibiae black, moderately long on the femora; anterior four tibiae with extremely short hair and with whitish sheen in some lights.

Wings with luteous tinge, the subcostal cell, a triangle extending over the cross-veins and a subrectangular spot before the apex of the wing dark brown; alula small.

Abdomen shining blackish, the second segment dull reddish, the apex becoming brown; base of third segment broadly reddish except in the middle. Pile black, longer and yellowish on the base of the abdomen. Abdomen slender, rather gently broadened on the apical half, but conspicuously narrower than in *bigoti*.

Types.—Holotype, male, and two paratypes, males, District of São Paulo, C. de Jordão, January 22, 1936 (F. Lane).



A NEW TRIACANTHID FISH AND OTHER SPECIES FROM  
DEEP WATER OFF VIRGINIABY J. T. NICHOLS AND F. E. FIRTH<sup>1</sup>

The fleet of Gloucester otter-trawlers which operate out of Norfolk, Va., and adjacent ports in the winter months, fishing in moderately deep water near the edge of the continental shelf, continue to turn up rare and interesting fishes.<sup>2</sup>

*Macrorhamphosus scolopax* (Linnaeus) and *Antigonia capros* Lowe are not rare in these waters. A few were taken in 1933 and more in 1936. The junior author has seen 4 of the former from 101 to 113 mm. standard length, and 9 of the latter from 58 to 118 mm. standard length taken between January and March, 1936, fishing in from 18 to 50 fathoms between Cape Hatteras and Cape Henry. Numerous specimens of *Peristedion miniatum* Goode, down to 74 mm. standard length (including rostral spines), were taken in 1936 fishing off Hatteras in from 10 to 18 fathoms, but this is very close to the edge of the continental shelf, and the trawls may have accidentally shifted out into deeper water. Seven additional specimens of *Anthias nicholsi* Firth, measuring from 112 to 160 mm. standard length, were also taken in 1936, in around 40 to 50 fathoms easterly of Cape Henry.

*Pontinus rathbuni* Goode and Bean has already been mentioned as a red deep-water scorpion fish taken by these trawlers. In the spring of 1933 two specimens of *Helicolenus dactylopterus* (De la Roche) turned up in 50 to 90 fathoms, east-southeast of Chesapeake lightship; and in February and March, 1936, in 50 to 60 fathoms easterly of Cape Henry, several specimens of both these species and a single fine specimen of *Scorpaena colesi* Nichols were obtained. This last, apparently the second specimen to be recorded, measures 200 mm. in standard length. It is whitish in preservative, with irregular dark blotches and specks on the sides, and a few specks on the fins; pectoral, ventral, anal and caudal with narrow blackish edging at their tips. Superficially all three forms are much alike in color and appearance.

<sup>1</sup> U. S. Bureau of Fisheries.

<sup>2</sup> See Pearson, 1932, U. S. Bur. Fish., Invest. Rept., No. 10; also Firth, 1931, Copeia (4), p. 162; 1933, Copeia (4), pp. 158-160; 1934, Copeia (1), p. 45; 1932, Fishing Gazette, XLIX (12), pp. 6-7.



The following are finds of greater importance:

*Polymixia nobilis* Lowe

This is another interesting species recently added to the fauna known from the edge of the continental shelf off Virginia. We have two specimens 100 mm. each in standard length, from 50 to 60 fathoms southeast by south of Cape Henry, Va., taken by trawlers in March, 1936.

Several species of this genus have been named in various parts of the world, but the fish seems everywhere to be rare and material for comparison seldom assembled. The American Museum collections contain only one additional specimen labeled *Polymixia japonica*, but without further data. After studying this scanty material and the literature, we agree with Günther, 1887, "Challenger" Rept., Zool., XXII, p. 34, that but a single widely distributed variable species is involved. However, specimens obtained in no two collections seem to be exactly alike, and we think it will be most helpful to identify these from Virginia by giving them a subspecific name. It should be noted that they agree well with one another and disagree markedly with the description of *Polymixia lowei* Günther from Cuba, the form previously described which is nearest them geographically.

*Polymixia nobilis virginica*, new subspecies

DESCRIPTION OF TYPE.—No. 13569, American Museum of Natural History, from 50 to 60 fathoms southeast by south of Cape Henry, Va., March, 1936, taken by trawlers.

Length to base of caudal, 100 mm. Depth in this length, 2.8; head, 3. Eye in head, 3; maxillary, 1.7; interorbital, 4; barbels, 1.2; width of body, 3; depth of peduncle, 3.3, its length, 2.4; longest dorsal spine (the last), 2.8; longest dorsal ray, 1.7; longest anal spine (the last), 3.3 (rays broken); caudal lobe, 1.2 1/2; pectoral, 1.4; ventral, 2.2. Snout in eye, 1.6.

Dorsal rays, V, 30; anal, IV, 16. Scales about 55.

Few fin rays, combined with deep, compressed body; snout roundish in profile, projecting but little beyond the tip of the lower jaw; maxillary to slightly beyond eye; long pectoral, and rather low vertical fins seem to characterize this subspecies. The scales are rough ctenoid with serrate edges, apparently characteristic of the genus though they are not so described for it.

Our second specimen has depth, 2.7 1/2; head, 3; eye, 3; dorsal, V, 26; anal, IV, 15; scales about 55.

*Triacanthodes zebra*, new species

DESCRIPTION OF TYPE.—No. 13568, American Museum of Natural History, from 50 to 60 fathoms of water, southeast to south-southeast of Cape Henry, Virginia, in March, 1936; taken by trawlers.

Length to base of caudal, 73 mm. Depth in this length, 1.6; head, 2.6. Eye in

head, 2.7; snout, 2.3; interorbital, 3.5; greatest width of body, 2.3; depth of peduncle, 3.2, its length, 3; pectoral, 2.3; ventral spine, 1.6; longest dorsal spine (tip broken), 1.2; longest dorsal ray, 2.4; anal ray, 2.5; caudal, 1.6. Width of mouth in eye, 2.3; width of gill slit, 2.3.

Dorsal rays, VI-16; anal, 13; caudal, 12; pectoral, 13; ventral, I, 1. Scales about 55 in a median line. Teeth conical; a main row of about 10 in the upper and 12 in the lower jaw, and back of this row about 2 teeth in each jaw. They are moderately large in front and small at the sides of the jaws.

Body compressed, rhombic; snout conical, meeting the convex, rounded interorbital in a concave angle. The back slants up steeply to the origin of the first dorsal spine, thence slightly downward to the origin of the soft dorsal, and more abruptly



Fig. 1. *Triacanthodes zebra*, photograph of type.

to the peduncle. The lower profile slants downward to the ventral spine, which slant is continued farther back when the slightly movable pubic bone (which is almost horizontal when elevated) is depressed. Shortly before the vent, which is placed just in front of the origin of the anal, the outline rounds up into a steep slant to the peduncle. Mouth small, terminal, the upper jaw protractile.

The origin of the first dorsal spine (the longest) is immediately over or very slightly behind the gill slit; and the spines are connected by membrane only at their bases and decrease in length so that the last is little more than one-third the diameter of the eye. The pectoral has a free fleshy base which slants downward and backward. The ventrals consist each of a strong slightly curved spine which locks when set, and a short, unbranched, threadlike ray. Caudal rounded.

Scales fused with the leathery skin, everywhere rough and spinulose, with spinules particularly well developed on the interorbital, also present on the dorsal and ventral spines, and there are a few small spinules on the bases of dorsal, anal and caudal rays. No evident lateral line.

Color in preservative grayish, with about 7 lengthwise dark stripes on each side, narrower than the interspaces. One of these runs from the eye to the base of the caudal, the one above it from over the eye to the dorsal axil. This specimen was found on the wharf at Norfolk, Va., where the fishing fleet had been landing its catch, in a somewhat dried condition, and was then distinctly greenish in color.

Apparently but a single specimen of this family has previously been recorded from American waters, namely *Hollardia hollardi* Poey from Cuba. Ours is obviously a different fish. Not only has it the dentition of *Triacanthodes*, but dissimilar body outlines, position of dorsal origin, and color pattern from those shown in Poey's figure of *Hollardia*, and much higher dorsal spines. It resembles *Triacanthodes ethiops* Alcock from the Bay of Bengal as figured, 1894, Jour. Asiat. Soc. Bengal, LXIII, Pl. VII, fig. 6, but has shorter ventral spines, etc.

#### *Chaunax nuttingii* Garman

Two small specimens of *Chaunax*, 70 and 80 mm. standard length, from 55 to 60 fathoms southeast by south of Chesapeake Lightship, taken in March, 1936, by Capt. Frank Favaloro of the boat "Grace F.," are provisionally referred to this species. We have compared them with specimens of *C. pictus* Lowe of different sizes and find certain differences which are outside the range of probable individual variation.

The "bait" is quite unlike that of any *C. pictus* to hand. It is sub-elliptical and about  $3/4$  as long as the eye, as the niche is in *C. nuttingii*. It is broad, fleshy, and leaflike on a broad fleshy stem, when depressed completely filling the pit or niche behind it, its membranous edges lapping over the edge of same. It is black in front or above, white behind or below, and the pit is black. The skin of the fish is also more finely granular than in *pictus*, there being 20 to 25 granulations versus 10 or 15 in a line crossing back of the pit between the rows of pores on top of the head.

The larger specimen, with belly loose and inflated, has depth in length to base of caudal, 2.4; head, 1.7; width of body, 2.8; eye in head, 7; snout, 6; interorbital, 4.5; maxillary, 3.3. The smaller specimen, with body much depressed, has depth, 3; head, 1.6; width of body, 2.8; eye, 7; snout, 5; interorbital, 4.5; maxillary, 3.2. There are 12 rays in the dorsal, 7 in the anal (imperfect in the smaller

specimen), 8 in the caudal, 13 to 14 in the pectoral; and 4 in the ventral.

Unfortunately the type of *C. nuttingii* cannot be located and is not available for comparison. Our specimens look much like the figure of that species except for the important matter of the bait, in *nuttingii* bilobed on a slender stalk, and described as shorter than the niche. There is the possibility that the *C. nuttingii* bait was imperfect or abnormal, or that this character is unreasonably variable. On the other hand there may be several instead of one or two species of this genus.



# AMERICAN MUSEUM NOVITATES

Number 884

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

October 13, 1936

## NOTES ON NEW AND RARE AMERICAN MYGALOMORPH SPIDERS

BY W. J. GERTSCH AND H. K. WALLACE

### Ctenizidae

#### Subfamily Ctenizinae

This subfamily comprises a large number of four-jointed ~~spiders~~ which, though essentially homogeneous in general facies, have been placed by modern authors in about ninety genera, many of which are monotypical. The genera and often the females of a given genus are difficult to identify because of an almost unparalleled variability in characters regarded as of primary importance, notably the relative size of the eyes and their arrangement. The males of a rather small percentage of the species are known, possibly because they desert their burrows at maturity to wander in search of the female. The great majority of the members of this group, which are predominantly tropical and subtropical in distribution, have developed the singular habit of dwelling in burrows in the ground, the entrances to which are closed and cleverly concealed by a silken lid of the spider's own fabrication. Only the closest scrutiny will disclose the average trap-door nest to the hunter. As a result, these secretive animals, eminently successful in living such a semi-sedentary life, seldom come to the notice of ordinary collectors. Trap-door spiders still remain a little-known element in the fauna of the United States. Occasional specimens have found their way into collections and literature, and a considerable number of species have been described, but the total of all the information accrued to date is very small.

#### CYCLOCOSMIA AUSSERER

*Cyclocosmia* AUSSERER, 1871, Verh. Zool.-Bot. Gesell., Wien, XXI, p. 144.

*Holonoprotus* Pocock, 1901, Proc. Zool. Soc., London, p. 209.

GENOTYPE.—*Mygale truncata* Hentz, from the southeastern United States.  
(Type of *Holonoprotus*, *H. ricketti* Pocock, from China.)

*Cyclocosmia truncata* (Hentz) is a trap-door spider which is remarkable for the peculiar shape of the abdomen and interesting in that it has been considered by some the rarest spider in North America. The

round, leathery, caudally truncated abdomen, in the absence of actual observations, has led to intriguing conjectures as to the use to which this part is put by the spider. Recent collections and observations of this species have added materially to what is known about it, both ecologically and morphologically, and have occasioned a review of the older literature and an analysis of the statements and conjectures contained therein.

The initial description of this unusual spider was by Nicholas Marcellus Hentz, the father of American Arachnology, who in 1841 gave it the name *Mygale truncata*. His specimens, all of which were females and all since lost, were from Alabama. In his words, "this spider dwells, like other species of this subgenus, in cylindrical cavities in the earth. Though many specimens were found, I never saw the lid described by authors as closing the aperture of its dwelling. The very singular formation of its abdomen, which is as hard as leather behind, and which forms a perfect circle, induces me to believe that it closes with that part, its dwelling, instead of with a lid, when in danger." What Hentz meant by "the lid described by authors" is inexplicable unless he was referring to the lids of nests of closely related spiders for, to our knowledge, he was the first man to see and record this species. Along with drawings of the animal, Hentz included a sketch of "the hole in in which it resides," a simple, circular hole in the ground, unadorned by any semblance of lid, turret or silken structure of any kind. Did Hentz actually see the entrance to a burrow? Did he draw upon nature or his imagination for a model for this sketch? We know that he never saw a lid and we can only surmise as to whether or not he saw the entrance.

We next hear of *truncata* in 1871 when Ausserer created two new genera, *Chorizops* and *Cyclocosmia*, for spiders differing from their nearest relatives in the possession of a truncated abdomen. Both these genera were erected wholly on the basis of the meager descriptions of Koch and Hentz, which fortunately were supplemented with recognizable figures of the spiders and the eye arrangements. At that time both were monotypical genera, but later a second species was to be added to *Cyclocosmia*. The genotype of *Chorizops* is *Actinopus loricatus* C. Koch from Mexico; of *Cyclocosmia*, *Mygale truncata* from Alabama. Of the habits of *truncata* Ausserer states: "Lebt in selbstgegrabenen Erdlochen, die jedoch nicht mit einen Decken verschlossen werden" and appends Hentz's statement of the probable use of the truncated abdomen.

Nineteen years later McCook, in his monumental work on 'American Spiders and Their Spinning Work,' treated the natural history of spiders in great detail. In his chapter on "Enemies and their influence on habit" *Cyclocosmia* is the subject of further speculation. Led on by the

singular "adaptation" of the abdomen and encouraged by the work of Hentz and Ausserer, McCook sees in this hard disk "one of the most curious examples of relation of structure to enemies, or perhaps of the reaction of hostile environment and agents upon structure." Relying solely upon Hentz for his information, but cautiously warning that Hentz's conjectures need confirmation, he agrees that it is not improbable that *truncata* uses its abdomen as a door to its burrow and appends a beautiful sketch of the spider in this imagined position. "And one may imagine the intellectual confusion of a pursuing enemy, which finds its prey suddenly disappearing within a hole in the ground, but which, when investigated, presents nothing but a level surface where certainly a hole ought to have been."

Simon's initial generic diagnosis of *Cyclocosmia* ('Histoire Naturelle des Araignées,' 1892-1895, I, p. 88) is spurious because it was based on *Cyclocosmia theveneti* Simon, a species from California, which was later placed by that author in a new genus, *Hebestatis* (Ann. Soc. Ent. Belgique, 1903, XLVII, p. 21). This genus is almost certainly a synonym of *Pachylomerus* as stated by Comstock in the 'Spider Book.' In the Supplement General of his 'Histoire Naturelle des Araignées' (Simon, 1897-1903, pp. 885-887) *Cyclocosmia* and *Chorizops* are compared for the first time by a modern author from an actual specimen of *C. loricatus* from Guanajuato, Mexico, and the excellent figures given by Pocock of *Holonoproctus ricketti* from China. Simon correctly identified this latter species as congeneric with *Cyclocosmia truncata* (Hentz).

In 1913 Comstock published his 'Spider Book.' His summary under the genus *Cyclocosmia* is interesting: only one species known from the United States and that from the work of Hentz; apparently only one specimen in collections, that one from Louisiana, belonging to and presumably still in the collection of Dr. Nathan Banks. During seventy-two years a species described as abundant yields only one specimen and no information concerning its habits or the nature of its burrow.

In 1933 a female specimen was found by a member of a collecting party from the Biology Department of the University of Florida, while picking through an accumulation of wet leaves along the margin of a small stream in the bottom of Torreya Ravine in Liberty County, Florida. Evidence seemed to point to its having been dislodged from its burrow by someone sliding down the nearby bank. Another collecting trip to the same locality in 1935 failed to produce additional specimens.



On the night of April 17, 1936, using a headlight for illumination, the junior author, in company with Mr. R. E. Bellamy, collected seven specimens, all females, in Torreya Ravine. The first specimen was found in its burrow by accident, while digging out a species of *Myrmekiaphila*, another trap-door spider belonging to the same family. Diligent search failed to reveal the entrance to a single burrow, but six additional burrows were transected and carefully excavated. The following night another large female was dug up in another locality in the same county. Again the mouth of the burrow escaped detection. Next day, while searching for trap-doors of a species of *Pachylomerus* in Gadsden County, a trap-door was found which at first was thought to belong to that genus. On removal of the external part of the nest, however, it was at once recognized as the burrow of *Cyclocosmia*. Two females were collected at this spot and one was taken alive to Gainesville. Only one lid was observed. The live specimen was provided with soil from her native environment and during the first night in captivity she began the construction of a nest on which she worked for ten nights. At the present time the nest resembles in every way the one observed in the field.

*Cyclocosmia truncata* seems to prefer a rather steep slope situated in a shady, cool, and more or less damp place. The ravines and stream valleys of northwest Florida afford many such situations. Some of these ravines are of especial ecological interest. "Along the eastern side of the Appalachicola River, in western Florida, is a series of high bluffs into which a number of small streams have cut narrow, steep-sided valleys, often well over 100 feet deep. Botanically, the cool humid ravines of this very restricted area have long been of great interest as the habitat of two endemic and very disjunct coniferous trees, *Taxodium taxifolium* ('Torreya,' savarn or stinking cedar) and *Taxus floridana* (Florida yew). Many other trees of these densely wooded ravines are of interest in that they occur in but a few or no other places in Florida and are only to be found commonly, elsewhere, much farther north. In fact, the general aspect of the flora of these ravines reminds one of regions in the Piedmont, despite the inclusion of a number of typical Florida plants. Beeches (*Fagus grandifolia*) vie with magnolia, spruce pines (*Pinus glabra*) and Torreya as the most dominant of the trees and these, with sweet gum, yellow poplar (*Liriodendron tulipifera*), white oak, sugar maple (*Acer floridanum*), hornbeam, redbud, holly and needle palms (*Rhaphidophyllum hystrix*) make up the bulk of the more conspicuous vegetation. A heavy leaf mould is present and herbs are scarce but *Mitchella repens*, *Trillium* sp., *Sanguinaria canadensis*, *Hepatica triloba*

and *Uvularia* sp., occur here and there on the steep slopes and contribute to the northern aspect of the vegetation.

"Small sandy bottom brooks flow along these ravines and often pass into short swampy reaches where they wander through tangles of standing and fallen vegetation and over deposits of rich organic silt. Near the bottom, springs and seepage areas are common and wet rotten wood, fungi, mosses and liverworts are abundant.

"The fauna of these ravines is as surprising and interesting as their flora, for here a number of animals reach their southernmost limits, frequently disjunct from the remainder of their ranges. In the Amphibia, Crustacea, Odonata, Ephemera and Orthoptera a number of unexpected, northern species or species with distinct northern affinities have been discovered and among the crane-flies more than a dozen species are found that have been taken nowhere else south of the Piedmont region."<sup>1</sup>

In every instance the burrow of *Cyclocosmia* was found in the sides of a steep, stream-cut bank in the bottom of a ravine or valley. The first burrows seen were in a vertical bank protected by the overhanging roots of a large tree. This particular type of situation is characteristic of these ravines where their streams have been actively degrading their courses. The exposed red and yellow sandy-clay surfaces are partially covered with mosses and liverworts. The burrows were found to be straight, cylindrical and almost vertical in every instance (see Fig. 1). They all occurred in firm damp earth, of a red to yellow color and of a sandy-clay nature. They all tapered uniformly and gradually to their bottoms, about one inch above which they were exactly the diameter of the hard disk of their occupant. Three specimens out of ten were found head-first in the bottoms of their burrows, in other words presenting their armor-plate to the intruder. In this position they fitted the cylindrical cavity so nicely, and they held on with their claws so tenaciously, that it was necessary to dig the earth away from around them in order to extricate them without injury. The other seven had backed down into their burrows and were more easily removed. The upper reaches of the burrows were larger in diameter, large enough to permit the spider to reverse her position at will. In several instances the bottom, but never the middle region, was found lined with silk.

As has been stated before, only one trap-door and one entrance were observed in the field. The trap-door was hinged at the top and similar

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<sup>1</sup> Rogers, J. Speed, 1933, "The Ecological Distribution of the Crane-flies of Northern Florida, Ecological Monographs, III, No. 1, pp. 24-25.

in shape to those of *Pachylomerus* but much thinner and quite flexible, thus belonging to the wafer type (Figs. 1 and 2). Observations indicated that the entrances of at least several burrows were located in or under leaf mould which had accumulated in spots on the sides of the banks.

The habits of the animal still remain unobserved. Nevertheless, the preliminary observations lead to the conclusion that *Cyclocosmia truncata* probably always constructs some kind of trap-door and that the truncated abdomen is useful for protection only when the animal has proceeded head-first to the bottom of the burrow. It is not tenable to believe it possible for the animal to plug the entrance to the burrow with its abdomen because of the disparity in diameter of leathery disk and entrance.

A comparison of the protective devices of the three trap-door spiders collected in west Florida is illuminating. *Pachylomerus audouini* relies upon an impregnable fortress. Her door is heavy and she holds it shut with surprising strength. *Myrmekiaphila torreyi* builds a rather futile outside door, which, in fact, usually stands wide open. She depends upon deception. Deep within her burrow is a secret side-chamber which is cleverly concealed by a trap-door. *Cyclocosmia truncata* combines both deception and the use of armor.

### *Cyclocosmia truncata* (Hentz)

Figures 1 and 2, 6 to 12

*Mygale truncata* HENTZ, 1841, Jour. Boston Soc. Nat. Hist., IV, p. 55, Pl. VII, fig. 1; 1868, idem, XI, p. 16, Pl. I, fig. 1 (reprint).

*Cyclocosmia truncata* AUSSERER, 1871, Verh. Zool.-Bot. Gesell., Wien, XXI, p. 145.—MARX, 1890, Proc. U. S. Nat. Mus., XII, p. 501 (check list).—MCCOOK, 1890, 'American Spiders and Their Spinning Work,' II, pp. 415-417, Figs. 353, 354 and 355.—BANKS, 1890, Bull. 72, U. S. Nat. Mus., p. 2 (check list; includes *Chorizops* as a synonym).—SIMON, 1897-1903, 'Histoire Naturelle des Araignées,' II, p. 887 (not Simon, 1892-1897, idem, I, p. 88).—COMSTOCK, 1913, 'The Spider Book,' pp. 237-238, Fig. 221.—BERLAND, 1932, 'Les Arachnides,' Encyclopedie Entomologique, Serie A, XVI, pp. 17-20.

FEMALE NEOTYPE.—Total length, including the chelicerae, 20.00 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	6.75		4.60	1.60	3.00	9.25 mm.
Width	5.90	3.90	3.65	1.15	1.75	8.80 mm.

Carapace dusky brown, with a faint greenish tinge, the cervical groove and the cephalic sutures darkened, the eyes ringed with black. Carapace nearly glabrous, with three long erect black spines on the midline just behind the posterior median eyes and a pair just in front of the anterior median eyes, otherwise with a few isolated inconspicuous black hairs. Pars cephalica very broad in front, elevated, very strongly convex, gently declining behind to the cervical groove. Pars thoracica low,

nearly flat. Outline of the carapace six-sided, essentially as in figure 6. Cervical groove a deep semicircular depression placed back four-sevenths of the total length of the carapace.

Clypeus horizontal, the anterior margin weakly rounded, weakly convex as seen from the side, the length exceeding the length of the eye group (100/85). Eyes practically sessile, on a very low tubercle which occupies two-fifths of the width of the head

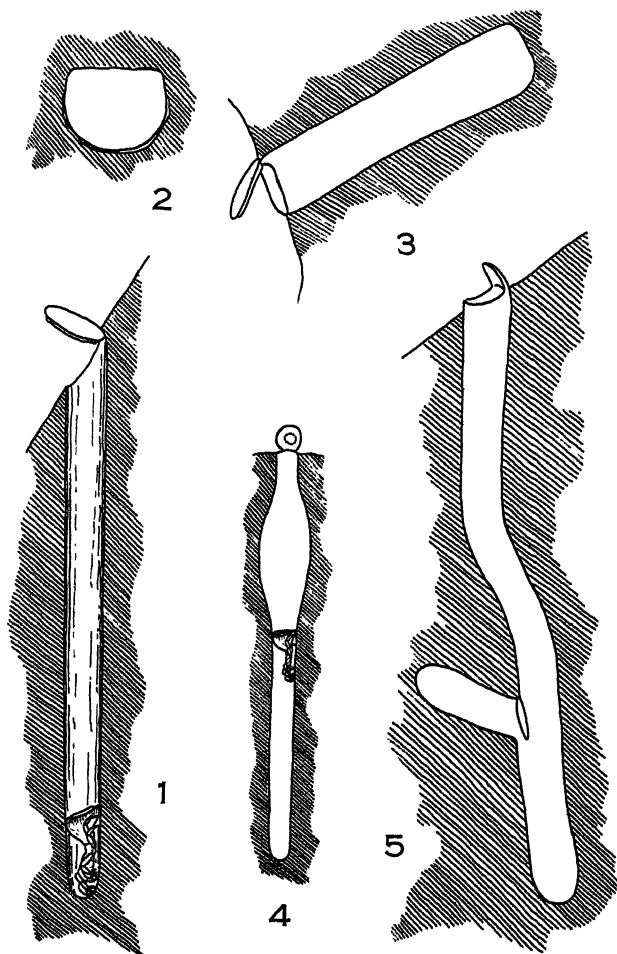


Fig. 1. *Cyclocosmia truncata* (Hentz), burrow of female.

Fig. 2. Idem, lid of burrow of female.

Fig. 3. *Pachylomerus audouini* (Lucas), burrow of female.

Fig. 4. *Galeosoma schreineri* Hewitt, burrow of female.

Fig. 5. *Myrmekiaphila torreyi*, new species, burrow of female.

at the first row of eyes. Ratio of the eyes: ALE:AME:PLE:PME = 40:30:36:30. First row of eyes very slightly wider than the second (38/37), straight, a line along the anterior margins of the eyes almost imperceptibly procurved, a line along the caudal margins also essentially straight. Anterior median eyes separated by less than a diameter (18/30), a full diameter from the laterals (33/30). Eyes of the second row very weakly recurved, the oval medians separated by scarcely three times their long diameter (83/30), about one-third of their short diameter from the lateral eyes (9/23). Median ocular quadrangle broader than long (124/75), narrowed in front

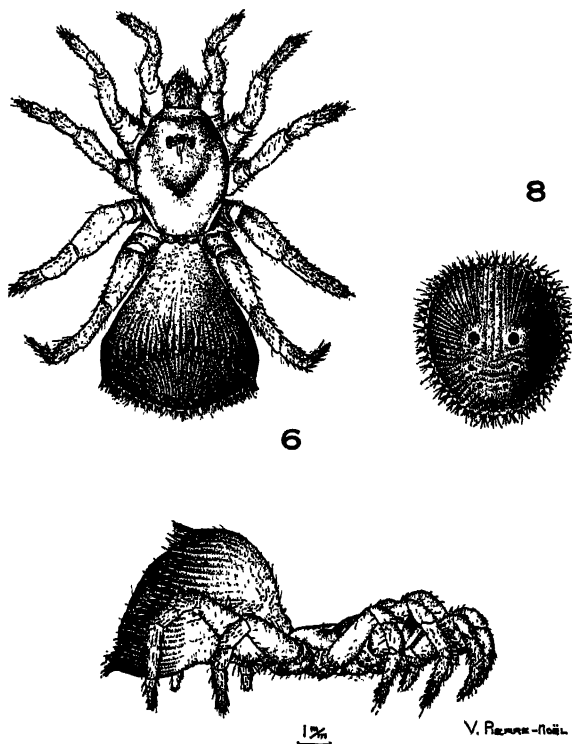


Fig. 6. *Cyclocosmia truncata* (Hentz), female, dorsal view.

Fig. 7. Idem, female, lateral view.

Fig. 8. Idem, eyes of young female.

Fig. 9. Idem, female, caudal truncature of abdomen.

(124/76), the eyes subequal. Lateral eyes of each side separated by the short diameter of the posterior median eyes. Curvature and eye arrangement as in figure 11.

Sternum (Fig. 12) longer than broad, shallowly emarginated in front, broadest at a point between the second and third coxae, clothed with black hairs that are more numerous on the margins. Underside paler brown than the dorsum. Posterior

coxae subcontiguous. Sigilla six, a small anterior pair placed near the margin opposite the first coxae, a second small pair near the margin opposite the second coxae and a large median pair which is indistinct and irregular in outline placed between the second coxae, and which is set obliquely, separated by half the width of one of them. Labium broader than long, broadly subtriangular, the distal rounded end with three black cusps (modified hairs), otherwise clothed with black hairs. Maxilla scarcely twice as long as broad, with ten conspicuous black cusps at the base on the prolateral side, numerous smaller ones along the prolateral margin of the ventral side, and a few others generally distributed on the ventral surface; maxilla otherwise clothed with long black hairs and a thin band of pale hairs along the prolateral face. Chelicera dark brown, stout and strong, flat on the prolateral face, convex on the retrolateral side, as seen from above twice as long as the width at the base, clothed at the distal end and on the prolateral margin of the dorsal side with very stout black spines. Rastellum very well developed, composed of short, robust, black spines which are set distally on a stout black process. Claw of the chelicera black, very heavy, gently curved. Retromargin of the furrow with nine stout black teeth, one of them smaller than the others. Promargin with fourteen teeth, a row of nine stout ones, which, however, are not as robust as those of the retromargin, and five small denticles placed near the furrow.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	4.50	2.75	3.00	2.35	1.50	14.10 mm.
II	3.60	2.30	2.10	2.25	1.35	11.60 mm.
III	3.50	2.65	2.00	2.15	1.70	12.00 mm.
IV	4.45	2.95	2.40	3.00	2.10	14.90 mm.
Palp	3.75	2.35	2.65		2.80	11.35 mm.

Legs short, the last two pairs relatively much stouter than the first two pairs. First leg: femur three and one-half times as long as broad, slightly curved; patella a little more than twice as long as broad (13/27); tibia proportionately about the same (13/30), as is the metatarsus (10/23); and the tarsus twice as long as broad (7/15). Dorsal faces of all joints of the first leg with a median row of very weak hair-like spines; ventral faces with rows of stout black hairs. Tibia, metatarsus and tarsus of the first leg with rows of stout black spines on the prolateral and retrolateral surfaces; the tibia with 31 retrolaterals in four irregular rows and 17 prolaterals arranged in two longitudinal rows; the metatarsus with 34 retrolaterals in three and about the same number of prolaterals; the tarsus with 21 on each side in three or four rows. Some of these spines nearly ventral in position. Palpus and second leg essentially similar in the spinal arrangement and in proportions. Comparative width and length of the joints of the third leg, measured from above, as indicated by the following ratios, the first number indicating the width: femur (17/35); patella (17/26); tibia (15/20); metatarsus (11/30); and tarsus (7/21). Idem for the fourth leg: femur (18/44); patella (15/29); tibia (15/24); metatarsus (10/30); and tarsus (6/21). Third and fourth legs essentially alike in dorsal spination, the femora with a row of weak hair-like spines, the patellae, tibiae and metatarsi with numerous short, pointed spines which are concentrated on the prolateral side. Tibiae of these legs with two or three weak distal spines; the metatarsi with a distal pair and a distal prolateral; the third tarsus with eight or ten terminal spines, the fourth tarsus with black

hairs only. Tarsus of palpus with a single claw which is armed at the base with a large tooth and a smaller one below. Claws on tarsi of legs three, the median small, the paired claws curved. Proclaw and retroclaw of the first and second tarsi with a single basal black tooth, which in the retroclaw of the left first tarsus has an additional weak pointed cusp below. Claws of the posterior tarsi similar, with the conventional large basal tooth but with an additional small tooth on the retroclaws.

Abdomen about as broad as long and as high as broad, broadly rounded basally on the sides and above but not overlapping the carapace, abruptly truncated caudally. Caudal truncature inclined forward at an angle of about thirty degrees from the vertical. Basal portion of the abdomen above and below, including the spinnerets, pale yellowish brown, the caudal portion black. Abdomen strongly sclerotized, coriaceous, more so caudally, with numerous longitudinal grooves, the elevations between broadened and flattened caudally, set with rows of black hairs, the distal end of each elevation forming a stout black projection on which are mounted from three to ten very strong black spines, the average about six, which overlap and completely fringe the caudal truncature. As seen from the posterior view the truncature is discoidal, with concentric grooves and six well-marked circular impressions; as viewed laterally the truncature is evenly convex. Details of the abdomen from above, from the side and from caudal view as shown in figures 6, 7 and 9. Spinnerets four, the one-jointed medians small, 1.10 mm. long, subcontiguous, the three-jointed large laterals (basal joint, 0.95 mm., the median, 0.65 mm., and the distal joint, 0.52 mm. long) separated by their width at the base. Bases of the four spinnerets in a weakly curved line, the medians slightly advanced. Distance between the spinnerets and the genital furrow, 2.20 mm.

VARIATIONS.—A second female, in which the abdomen is broken off and mutilated, agrees in detail with the neotype but differs in having the eyes of the first row slightly farther apart (Fig. 10).

A third female from Liberty County, Florida, taken May 5, 1933, the first example of this rare species taken in recent years, is much smaller and differs somewhat from the neotype which is probably adult. This spider was the basis for the detailed figures illustrating the species (Figs. 6, 7 and 9).

Total length, including the chelicerae, 10.25 mm.

Whole spider paler than in the older specimen. Structure essentially as described for the neotype but the spines less robust on the legs and the cusps on the maxillae fewer. The eye arrangement differs chiefly in having the first row weakly recurved, not nearly so strongly, however, as illustrated in figure 8.

TYPE LOCALITY.—Females from Alabama, all lost (Hentz, 1841).

DISTRIBUTION.—Louisiana: female in collection of Nathan Banks (Comstock, 1913, p. 238). Alabama: (Hentz, 1841). Florida: Torreya Ravine, Liberty County, May 5, 1933, female (Wallace collection); April 17, 1936, seven females (R. E. Bellamy and H. K. Wallace); Gadsden County, April 19, 1936, two females (R. E. Bellamy and

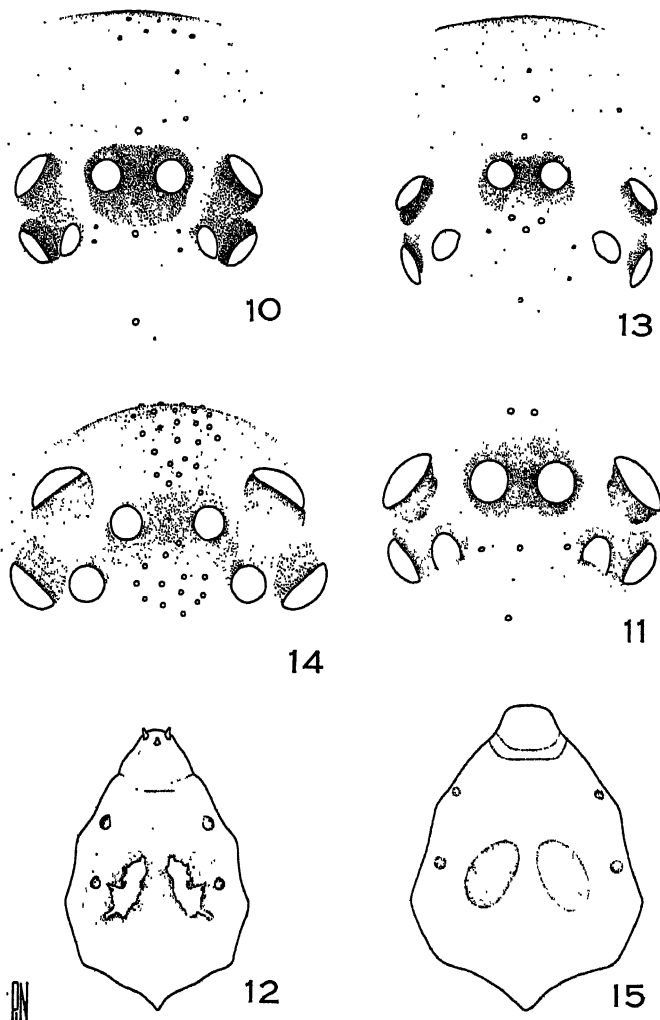


Fig. 10. *Cyclocosmia truncata* (Hentz), eyes of female.

Fig. 11. Idem, eyes of female neotype.

Fig. 12. Idem, sternum of female.

Fig. 13. *Chorizops loricatus* (Koch), eyes of female.

Fig. 14. *Pachylomerus audouini* (Lucas), eyes of female.

Fig. 15. *Myrmekiaphila torreyi*, new species, sternum of female.



H. K. Wallace). Three of the females noted above are in the collection of The American Museum of Natural History. The other specimens from Florida are at present in the collection of H. K. Wallace.

#### CHORIZOPS AUSSERER

*Chorizops* AUSSERER, 1871, Verh. Zool.-Bot. Gesell., Wien, XXI, p. 144. (This genus precedes *Cyclocosmia* which is diagnosed on the same page.)

GENOTYPE.—*Actinopus loricatus* C. Koch, from Mexico.

The sole member of this genus, *Chorizops loricatus* (C. Koch), has been found only on two occasions since the initial description of the species by Koch. Ausserer established the genus on the basis of the characters given in the description and figures of Koch whose diagnosis is essentially accurate. The genus is distinct from *Cyclocosmia* in the recurvature of the anterior eye row and in the considerable separation of the median eyes from the laterals. It further differs in having a slight, glabrous depression at the base of the third tibia on the prolateral side which is analogous to that of *Pachylomerus*. The discovery of males of *loricatus* and *truncatus* will, no doubt, establish the validity of keeping the two genera separated. The differences between the species, however weighty, are far overshadowed by the precise similarity in most other characters.

Nothing has been published on the biology of *loricatus*, but it seems reasonable to suppose that the burrows and the habits of the species conform essentially to what is known of *Cyclocosmia truncata*. The sclerotized caudal truncature presumably serves as an impregnable barrier to predaceous or parasitic enemies which may invade the premises of the spider for food or for a site for an egg or larval parasite. The same immunity seems to be shared by still another spider, *Galeosoma schreineri*, a species of another group in which the abdomen is truncated. A figure of the burrow of this species and the position of the spider within are reproduced (Fig. 4) for comparison with the American species. The tenacious adherence of the spider to the sides of the burrow is facilitated in *Chorizops* and *Cyclocosmia* by the fringe of strong spines around the margins of the caudal truncature.

#### *Chorizops loricatus* (C. Koch)

##### Figure 13

*Actinopus loricatus* C. KOCH, 1842, 'Die Arachniden,' IX, p. 99, Pl. CCCXXIII, fig. 752.

*Chorizops loricatus* AUSSERER, 1871, Verh. Zool.-Bot. Gesell., Wien, p. 144.—SIMON, 1897, Bull. Soc. Ent., France, p. 172, figs. 1-3; 1897-1903, 'Histoire Naturelle

des Araignées,' II, p. 887.—PETRUNKEVITCH, 1909, American Museum Journal, IX, p. 251, 3 figures; 1911, Bull. American Mus. Nat. Hist., XXIX, p. 54 (check list).

FEMALE NEOTYPE.—Total length, including the chelicerae, 16.75 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	5.70		3.50	0.80	2.00	9.50 mm.
Width	4.60	2.75	3.00	1.10	1.25	7.80 mm.

Cephalothorax above and below and appendages bright orange-brown in color. Carapace glabrous except for two erect long spines on the clypeus just in front of the anterior median eyes, four behind the posterior median eyes and two weaker spines near the cervical groove. Margins of the carapace with a few weak hairs. Pars cephalica very broad in front, as seen from above forming a subequilateral triangle, the clypeus gently rounded in front, the cervical groove a deep semicircular depression. Pars cephalica strongly and evenly convex, much higher than the less convex, lower pars thoracica. Carapace widest at a point between the second coxae.

Clypeus horizontal, convex as viewed from the side, the length exceeding the length of the eye group (95/80). Eyes on a very low, inconspicuous tubercle, virtually sessile, which occupies half the width of the head at the first eye row. Ratio of the eyes: ALE:AME:PLE:PME = 33:22:26:24. First row of eyes very slightly wider than the second, moderately recurved, a line along the anterior margins of the laterals cutting the centers of the medians. Anterior median eyes separated by scarcely a diameter (20/19), scarcely two diameters from the lateral eyes (23/42). Eyes of the second row moderately recurved, a line along the anterior margins of the laterals cutting the centers of the oval medians, the medians separated by four times their long diameter (24/54), separated from the laterals by less than their short diameter (17/10). Median ocular quadrangle much broader than long (67/33), much narrower in front (67/28), the eyes subequal. Lateral eyes of each side separated by the short diameter of the posterior medians. Curvature and arrangement of eyes as in figure 13, the size of the posterior lateral eyes, however, being proportionately too large.

Sternum longer than broad, clothed with short erect black hairs, very shallowly emarginated in front, differing in shape in no important particular from that of *Cyclocosmia truncata* (Fig. 12). Sigilla very indistinct, presumably lacking the first pair of small submarginal ones between the first coxae but with indications of a small submarginal pair between the second coxae and the large median pair as in *truncata*. Maxilla scarcely twice as long as broad, evenly clothed with long pale hairs, the ventral face with numerous short clavate hairs (cuspules), concentrated particularly on the prolateral side, and four conspicuous black cusps near the base. Chelicera less powerful than in *truncata*, longer than broad as seen from the side (17/12), flattened and practically smooth on the prolateral surface, convex and smooth on the retrolateral side, nearly three times as long as the width at the base. Terminal part of the chelicera clothed with stout spines. Rastellum composed of twelve very robust short spines which are set on a stout projection. Promargin with a row of seven large teeth and four smaller ones placed near the furrow. Retromargin with six very large teeth.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	3.25	2.10	2.00	1.50	1.30	10.15 mm.
II	3.00	2.00	1.50	1.50	1.25	9.25 mm.
III	2.80	2.00	1.30	1.50	1.40	9.00 mm.
IV	3.15	2.15	1.50	2.10	1.40	10.30 mm.
Palp	2.15	1.80	1.70		2.00	7.65 mm.

Leg formula, 4132. Spination of legs and armature of tarsal claws in complete agreement with *Cyclocosmia truncata* (Hentz). Tibia of the third leg with a very weak constriction, a shallow glabrous groove, near the base.

Abdomen longer than broad, nearly as high as broad, broadly rounded basally, cylindrical, as viewed from the side ascending sharply from the pedicel and flattening out more quickly than in *truncata*, the abdomen proportionately longer and the caudal truncature more precipitous, inclining forward at an angle of about twenty degrees from the vertical. Abdomen strongly sclerotized, coriaceous, with longitudinal grooves and low ridges which are thickly studded with very small tubercles and clothed with two rows of hairs. Distal ends of the ridges forming stout black projections on which are set a row of fine long spines, about twelve on the average, one of which is much longer than the others on each projection. Caudal truncature discoidal, weakly convex as seen from the side, with concentric grooves and ridges and six circular impressions. Spinnerets as in *truncata*.

TYPE LOCALITY.—Mexico.

RECORDS.—Guanajuato, Mexico, female (Dr. A. Dugés) (Simon, 1903, pp. 885 and 887), in the Muséum de Histoire Naturelle, Paris. La Buena Ventura, Vera Cruz, Mexico, August, 1909, female neotype (Dr. A. Petrunkevitch, 1909, p. 251), in The American Museum of Natural History.

#### PACHYLOMERUS AUSSERER

*Pachylomerus* AUSSERER, 1871, Verh. Zool.-Bot. Gesell., Wien, XXI, p. 145.

GENOTYPE.—*Pachylomerus nidulans* (Fabricius).

Several females, presumed to be *Pachylomerus audouini* (Lucas), were collected in ravines in Gadsden and Alachua Counties. In both localities the nests were located in the sides of steep, stream-cut banks where roots of trees and bushes have served to hold in place the soil of the exposed surfaces. The ravines were shady, cool and moist. The burrows were all shallow (five to eight inches deep), lined with silk throughout, and provided with a door of the cork type (Fig. 3). In one case, where a large tree had been partially undermined by stream action so that its roots overhung a thirty foot precipitous bank, nests were observed which went straight up from beneath into the heart of the tree, so that the doors hung open. Both inhabited and abandoned nests having this disposition were observed. The nests are usually horizontal,

slightly inclined or moderately declined. When disturbed the spider holds the door shut with surprising strength.

#### MYRMEKIAPHILA ATKINSON

*Myrmekiaphila* ATKINSON, 1886, Entomologica Americana, II, p. 132.

GENOTYPE.—*Mygale fluviatilis* Hentz (*M. foliata* Atkinson).

The nest of *Myrmekiaphila fluviatilis* (Hentz) was described in some detail by George F. Atkinson in 1886 under the name of *foliata* (Entomologica Americana, II, pp. 113–117, Pl. v, figs. 15 and 16). The following notes refer to a recently discovered species from Florida, *Myrmekiaphila torreya*, new species.

The density of population of the *Myrmekiaphila* from Torreya Ravine, Liberty County, Florida, is striking. The average number of adult females inhabiting the slopes of this ravine must be close to one per square yard. Smaller numbers were also observed and collected in other ravines and stream valleys in Liberty and Gadsden Counties. They are apparently restricted to the slopes and miniature stream-cut, sandy-clayish cliffs of the damp, cool shady ravines mentioned above. Burrows were observed in exposed banks but the greatest concentration of specimens was observed on the leaf-mould covered slopes of Torreya Ravine. Of over two hundred specimens collected to date only one, the holotype, is a male.

*Myrmekiaphila torreya* digs a burrow which, on the average, is about ten inches deep. The burrows, usually found in a sandy soil penetrated by a maze of roots, almost always prescribed an arc or contained at least one more or less abrupt bend (Fig. 5). Several inches from the bottoms of the burrows there were short side chambers (one to a burrow) masked by wafer-type doors. The entrances to the burrows were lined with silk and provided with a peculiar type of door which, when standing open, is more like a silken collar than a trap-door, but which took on the appearance of a well-camouflaged trap-door of the wafer type when closed by a slight push from a pair of forceps. The spiders usually leave these doors standing open during both night and day. As a matter of fact only one female was observed to close her door, and this one did so like a flash.

#### *Myrmekiaphila torreya*, new species

Figures 15, 17 to 25

MALE HOLOTYPE.—Total length, including the chelicerae, 16.50 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	7.40		4.00	1.40	2.50	6.30 mm.
Width	5.60	3.65	3.50	0.80	1.50	4.00 mm.

Carapace orange-brown, the pars cephalica somewhat infuscated, with a median narrow black line that runs from the cervical groove forward to the posterior eye row, the eyes ringed with black and enclosing a black area, the pars thoracica infuscated on the margins. Carapace (see Figs. 21 and 22 for the female) longer than broad, broad in front, irregularly indented on the margins of the anterior half, more evenly narrowed caudally, widest at the second coxae. Lateral margins of the carapace set with rows of stout black spines which are more numerous caudally. The whole carapace otherwise clothed sparsely with procumbent fine black hairs and a few weak spines. Cervical groove a deep transverse depression located back four-sevenths of the total length (46/74), the width of the groove one-fifth the width of the carapace at that point (1.10 mm./5.30 mm.). Pars thoracica moderately convex, rather low, the lateral striae indicated as paler stripes. Pars cephalica much higher, more strongly convex, subtriangular in outline from above, the cephalic grooves well indicated.

Eyes on a low tubercle one-third as wide as the front. Clypeus scarcely as high as the diameter of an anterior median eye, with a strong upright black median spine and three smaller spines on each side, the groups of spines occupying an area as wide as that occupied by the median eyes. Caudal edge of the eye tubercle with three stout spines which overlap the interval between the posterior median eyes. Ratio of the eyes: ALE:AME:PLE:PME = 33:23:28:23. First row of eyes procurved as seen from above, the medians separated by less than a diameter (23/13), as far from the much larger laterals. Second row of eyes recurved, the irregular suboval medians separated by two diameters (23/44), separated by less than half a diameter from the narrowly oval laterals (23/9). Median ocular quadrangle broader than long (82/50), much narrower in front (82/52), the eyes subequal. Lateral eyes of each side separated by the diameter of an anterior median eye. Curvature and eye arrangement as in figure 23.

Sternum longer than broad, broadly emarginated in front, broadest between the second and third coxae, set with strong erect black hairs which are more numerous on the margins, especially in the caudal half, with which are interspersed black hairs. Sigilla four, the anterior margins nearly on a line with the middle of the second coxae, the median ones large, oval, separated by one-fourth their length, one-third their length from the much smaller lateral ones which are nearly on the margins. Labium broader than long, the breadth an arbitrary measurement because of the intimate juncture in the emarginated distal end of the sternum, the anterior margin with long black hairs, the ventral face with shorter black hairs, no cusps present. Whole underside concolorous with the carapace, a little paler and not infuscated. Maxilla longer than broad, the endite weakly developed, the prolateral margins with a thick brush of fine reddish hairs, the ventral face with a series of short clavate to subspatulate hairs, otherwise clothed with weak black hairs. Three posterior coxae subequal in length, the first coxa slightly longer, all clothed evenly with erect black hairs. Chelicera as broad in lateral view as long, scarcely twice as long as broad at the middle

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	5.70	3.00	4.10	3.50	3.20	19.50 mm.
II	5.00	2.70	3.50	3.65	2.80	17.65 mm.
III	4.10	2.65	2.50	4.20	2.65	16.10 mm.
IV	5.75	3.25	4.75	5.25	3.25	22.25 mm.
Palp	3.40	1.80	2.75		1.20	9.15 mm.

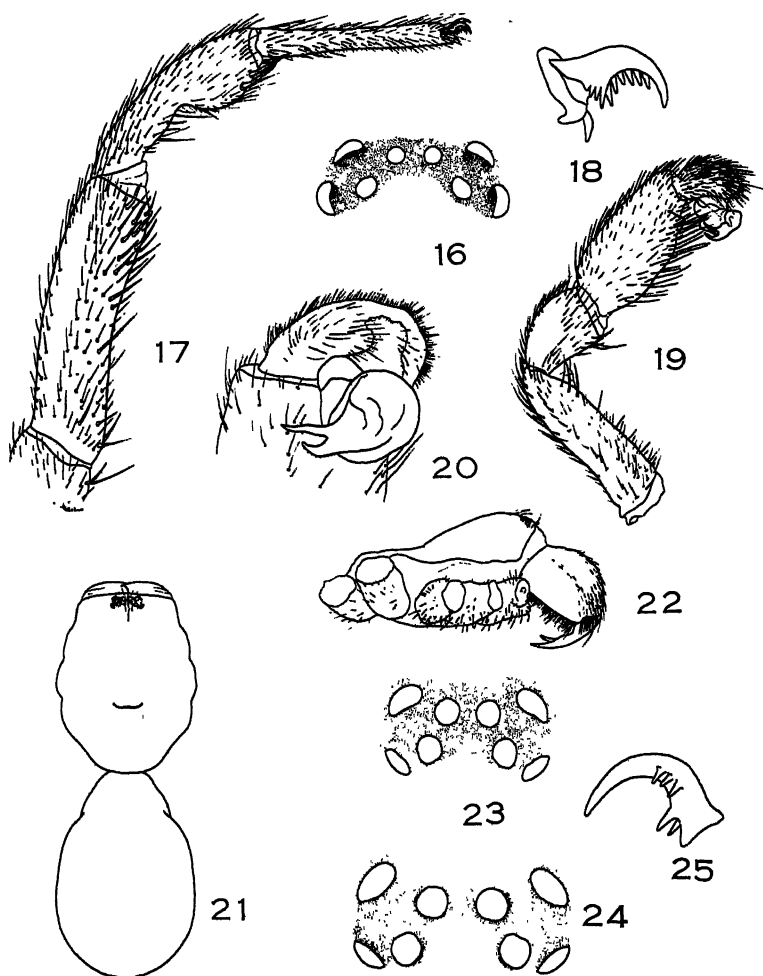


Fig. 16. *Myrmekiaphila fluviatilis* (Hentz), eyes of a female.

Fig. 17. *Myrmekiaphila torreyi*, new species, first right leg of male, retrolateral view.

Fig. 18. Idem, retroclaw of first right tarsus of male, retrolateral view.

Fig. 19. Idem, right palpus, retrolateral view.

Fig. 20. Idem, tarsus of bulb of male right palpus, ventral view.

Fig. 21. Idem, female, dorsal view, the appendages omitted.

Fig. 22. Idem, carapace of female, lateral view.

Fig. 23. Idem, eyes of male.

Fig. 24. Idem, eyes of female.

Fig. 25. Idem, proclaw of first right leg of female, retrolateral view.

as seen from above, the distal end with a covering of black hairs. Both margins of the furrow with a band of fine black hairs, the promargin armed with a series of about sixteen small teeth, the retromargin with a line of very small denticles. Rastellum well developed, made up of stout spines set on a stout apophysis.

Leg formula, 4123. First femur three and one-half times as long as broad, armed above with a median row of seven spines and with two additional distal prolaterals, otherwise clothed with strong black hairs. Distal joints of the first leg as figured (Fig. 17), the tibia about three times as long as broad, slightly thicker at the distal end, set with nine strong spines on the retrolateral side which are concentrated in the distal half of the joint and a like number on the prolateral surface but set farther back. First metatarsus strongly incrassated at the distal end on the ventral side, armed with a distal pair of black spines and a single spine directly behind the one on the retrolateral side. Other legs normal in shape, heavily clothed with strong spines and black hairs. Tarsal claws of all legs similar, in a double series, with five or six long teeth near the base in one row which is followed by a second row of five subequal short denticles (Fig. 18). Details of the palpus as illustrated (Figs. 19 and 20), the femur three times as long as broad, slightly curved, shallowly excavated on the prolateral side, clothed with black hairs and a few weak terminal spines. Tibia thickened, twice as long as broad, with a strong terminal tubercle on the retrolateral side. Tarsus and details of the bulb well shown in figure 20, the terminal portion deeply bifid, the lower branch, which is more curved and shorter than the upper, with a row of small teeth on the lower side.

Dorsum of the abdomen dusky brown, the venter paler, clothed with black hairs. Spinnerets four, the median ones one-jointed and short (0.50 mm.), the lateral pair three-jointed, robust, the basal joint, 1.10 mm., the median, 0.60 mm., and the conical terminal joint, 0.25 mm. long. Bases of the four spinnerets in a weakly recurved line, the medians separated by their width, the laterals by two-thirds their width.

FEMALE ALLOTYPE.—Total length, including the chelicerae, 23.50 mm.

CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length 8.50		5.00	1.10	3.50	11.00 mm.
Width 7.00	5.25	4.50	1.50	2.00	7.25 mm.

Carapace orange-brown, the pars cephalica slightly darker, clothed very sparsely with inconspicuous black hairs. Carapace longer than wide, very broad in front, gently rounded on the sides, broadly rounded behind. Shape essentially as in figures 21 and 22, which were drawn from a small female. Cervical groove a deep, transverse, weakly procurved depression (1.50 mm.) which is placed back three-fourths of the total length of the carapace. Pars thoracica nearly flat, the pars cephalica strongly elevated, convex, the head sutures well marked.

Eyes on a low tubercle which is about three-tenths as wide as the front and placed on the clypeal margin, the eyes being scarcely a diameter of the anterior medians from the front edge. Spines in ocular area as in the male but all of them weak. Ratio of the eyes: ALE:AME:PLE:PME = 38:22:21:25. First row of eyes procurved as viewed from above, the medians separated by exactly their diameter, as far from the much larger laterals. Second row of eyes weakly recurved, the oval medians separated by more than twice their long diameter (23/60), separated from the smaller laterals by one-third their diameter (9/23). Median ocular quadrangle broader than

long (100/58), narrowed in front (100/65), the eyes subequal in size. Curvature and relations of eyes essentially as in figure 24, which, however, is of another female in which the posterior lateral eyes are proportionately larger than in the allotype. A figure of the eyes of *Myrmekiaphila fluviatilis* (Hentz) is included for comparison (Fig. 16).

Underside of the carapace clothed as in the male but with the following differences. Labium with three black spatuliform hairs (cuspules) at the distal end. Lateral sigilla on the sternum (Fig. 15) their diameter from the margin and quite as far from the very large median sigilla which are subcontiguous. Chelicera as in the male, the promargin with a series of ten, subequal, stout black teeth, the upper margin with a row of five small denticles and a group of smaller denticular elevations. Retromargin with a thick band of hairs, the promargin with a light band. Rastellum well developed, the terminal spines set on a strong black plate.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	5.25	3.35	3.60	3.00	1.85	17.05 mm.
II	4.55	3.10	3.00	2.80	1.75	15.20 mm.
III	3.70	2.90	2.00	2.80	2.25	13.65 mm.
IV	5.20	3.80	4.50	4.25	2.40	20.15 mm.
Palp	3.50	2.00	2.40		2.20	10.10 mm.

Leg formula, 4123. Legs much stouter and less spinose than in the male. First femur slightly curved, shallowly excavated and smooth on the prolateral side, nearly four times as long as broad, clothed with inconspicuous black hairs and a line of weak dorsal spines. Terminal joints with weak dorsal spines, the tibia with two median ventral spines on the retrolateral side, the metatarsus with 1-2-2 stout ventral spines, the last pair distal and a distal prolateral. Second leg as the first but the metatarsus with 2-2-(1)-2 ventrals and a median prolateral and distal retrolateral spine. Third leg more spinose than the others, the dorsal surfaces of the patella and tibia with rows of short spines, the tibia with 2-2-2 ventrals, 1-1 prolaterals and 1-1-2 retrolaterals, the metatarsus with 2-1-2 ventrals, 2-2-1-2 prolaterals and 1-2-1-1 retrolaterals. Fourth leg unarmed above, the tibia with 2-2-2 ventrals, 0-1-0 prolaterals and 1-1-1 retrolaterals, the metatarsus with 0-1-1-0 retrolaterals, 2-1-1-2 ventrals and 1-0-0-1 prolaterals. Spinal formula inconstant. First two tarsi thickly scopulate beneath, the last two less thickly clothed with scopular hairs. Tarsal claws three, the median one small, the paired claws essentially similar though somewhat variable (Fig. 25). Retroclaws and proclaws with two denticles near the base, the lower one much smaller, and a series of three or four on the inner face. Both paired claws of the fourth tarsus usually lacking the lateral denticles.

Dorsum of the abdomen uniform dusky brown, the venter a little paler. Spinnerets shorter and stouter than in the male, the median pair one-jointed (0.60 mm. long), separated by their width, the lateral pair separated by their width, the basal joint, 1.00 mm., the median, 0.40 mm., and the conical distal joint, 0.35 mm. long.

VARIATIONS.—Spiders of all sizes are represented in the more than one hundred and thirty female paratypes. There is considerable variation in the color of the abdomen and in structural characters. The differences in color do not seem to be correlated with age. The para-



type from Gadsden County has the abdomen unusually pale, the dorsum being gray and marked with a narrow longitudinal dark streak for two-thirds the length. Many females of all sizes have a definite pattern of transverse dark bands on the dorsum of the abdomen through which often runs a median dark stripe. In many others, including the allotype, the bands are coalesced or the pattern is completely masked by dusky brown chromatism which obscures the pattern. Variation in the comparative width and length of the carapace is considerable. The general relations of the eyes are relatively constant but the size of the eyes is subject to considerable variation. This naturally affects the distances between the various eyes. The posterior lateral and median eyes of each side may be clearly separated, subcontiguous or coalesced. The degree of curvature is essentially constant.

TYPE LOCALITY.—Male holotype, female allotype and twenty-one paratypes from Torreya Ravine, Liberty County, Florida, April 10, 1935 (H. K. Wallace); six female paratypes, April 11, 1935 (H. K. Wallace); April 17, 1936, seventy-seven female paratypes (R. E. Bellamy and H. K. Wallace); April 18, 1936, twenty female paratypes (R. E. Bellamy and H. K. Wallace). Gadsden County, Florida, April 14, 1935, female paratype (H. K. Wallace). Leon County, Florida, April 15, 1936, five female paratypes (R. E. Bellamy and H. K. Wallace); April 16, 1936, six female paratypes (James Rogers and H. K. Wallace). The holotype, allotype and numerous paratypes are in the collection of The American Museum of Natural History. Female paratypes in the collection of Mr. H. K. Wallace.

#### EUTYCHIDES SIMON

*Eutychides* SIMON, 1888, Ann. Soc. Ent., France, (6) VIII, p. 214.

GENOTYPE.—*Eutychides aurantiacus* Simon.

#### *Eutychides arizonicus*, new species

Figures 26 to 31

MALE HOLOTYPE.—Total length, including the chelicerae, 15.50 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	6.00		3.70	0.75	2.50	7.50 mm.
Width	5.00	3.15	3.00	1.00	1.25	4.70 mm.

Pars cephalica orange-brown, the pars thoracica paler, the thoracic striae darkened, the eyes narrowly ringed in black and enclosing a black field. Carapace longer than broad, three-fifths as broad in front as the broadest point between the second coxae, the front subtruncate but somewhat produced below the eyes, the sides gently rounded, irregular, the caudal margin subtruncate (see Fig. 30). Cervical groove a

deep, transverse, semilunar, procurved depression, 1.00 mm. in width, about one-fourth the width of the carapace at that point and situated back two-thirds of the total length of the carapace. Pars thoracica moderately convex, rather flat, much lower than the triangular convex pars cephalica which in lateral view drops off evenly to the cervical groove. Carapace clothed sparsely with rows of soft black hairs and a very few weak spines on the midline.

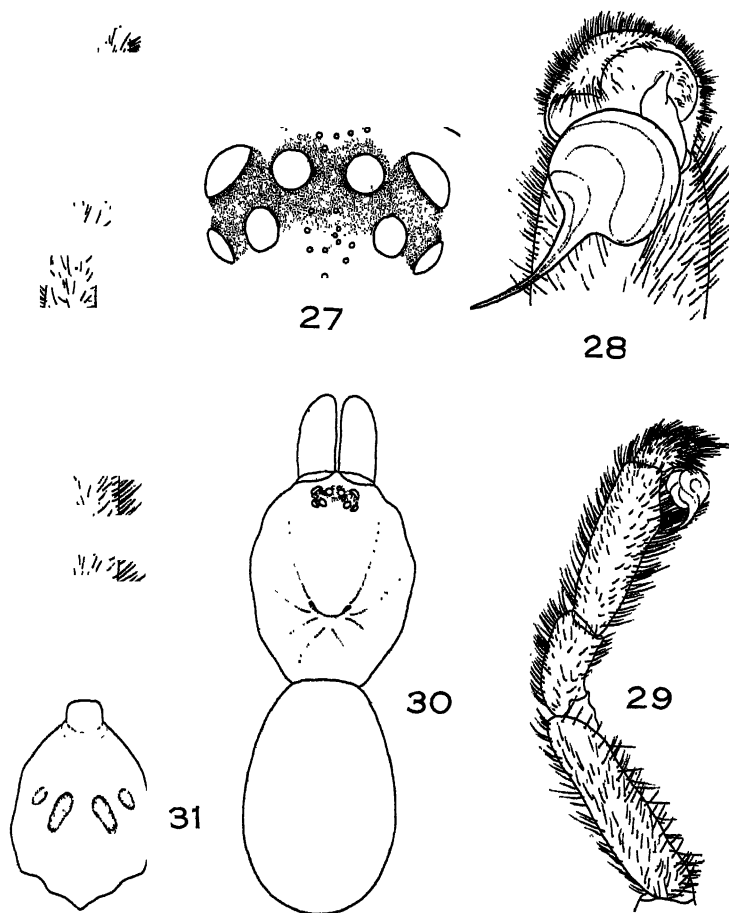


Fig. 26. *Eutyichides arizonicus*, new species, tibia and metatarsus of first right leg of male, dorsal view.

Fig. 27. Idem, eyes of male.

Fig. 28. Idem, tarsus and bulb of right palpus, ventral view.

Fig. 29. Idem, right palpus, retrolateral view.

Fig. 30. Idem, carapace and abdomen of male, dorsal view.

Fig. 31. Idem, sternum of male.

Eyes on a low tubercle which occupies scarcely one-half the width of the head at the second eyes (7/18). Clypeus scarcely as high as the diameter of an anterior median eye, with five strong erect spines and a series of smaller ones below the anterior medians. Ratio of the eyes: ALE:AME:PLE:PME = 38:23:23:23. First row of eyes slightly wider than the second, straight, the anterior margins of the eyes forming a straight line, the medians separated by less than a diameter (23/16), nearer the laterals (23/13). Second row recurved, the oval medians separated by twice their long diameter, less than a radius from the laterals (23/10). Median ocular quadrangle broader than long (90/65), narrowed in front (90/67), the eyes subequal. Lateral eyes of each side separated by scarcely the short diameter of the anterior medians. Curvature and eye arrangement as in figure 27.

Sternum longer than broad, clothed with black hairs which are stouter on the margins, with four well-marked sigilla, the median pair large, oblique, separated by their width, about as far from the smaller laterals which are near the margins (Fig. 31). Labium broader than long, clothed with black hairs. Maxilla twice as long as broad, clothed with black hairs, the inner margin with a thick brush of soft brown hairs, the base with a few short clavate hairs. Chelicera about as broad as long as seen from the side, the outer margin moderately convex, the inner (promargin) flattened, the clothing black hairs which are more numerous and longer along the inner dorsal margin. Promargin armed with six subequal teeth which are spaced apart about their width at the base; retromargin with a row and a group of very small denticles. Rastellum moderately well developed, composed of several rows of discrete, subequal black spines which are more numerous at the distal end.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	5.50	2.85	3.60	3.40	2.00	17.35 mm.
II	5.20	2.60	3.00	3.50	1.75	16.05 mm.
III	4.00	2.40	2.80	3.20	1.90	13.80 mm.
IV	5.20	3.00	4.10	4.60	2.40	19.30 mm.
Palp	3.48	1.70	2.70	1.15	1.15	9.03 mm.

Leg formula, 4123. First leg with few spines (Fig. 26), the femur nearly five times as long as broad, clothed with black hairs, the patella about twice as long as broad, clothed with black hairs. Tibia nearly three times as long as broad, armed at the distal end on the retrolateral side with a group of five stout spines, four of them on an elevated tubercle, and one directly behind; also armed ventrally with three single median spines on the retrolateral side. First metatarsus three and one-half times as long as broad, slightly sinuous, excavated in the basal half on the retrolateral side and armed just beyond the middle of that surface with a stout tubercle. Metatarsus and tarsus clothed thickly beneath with light scopular hairs, the former with three ventral distal spines. Second leg normal, the tibia with four single ventral spines, the metatarsus with two single spines in the basal half and three distals, the tarsus and metatarsus of this leg scopulate beneath. Third leg with several weak ventral and lateral spines on the tibia, the metatarsus with 3-4 ventrals and an additional distal pair, five single retrolaterals and seven prolateral spines. Fourth leg with 2-1-2 spines beneath the tibia, 1-2-2-2 ventrals, 1-1-1-1 prolaterals and 1-1-1 retrolaterals on the metatarsus. Posterior tarsi scopulate beneath. Legs without dorsal spines. Claws three, the paired claws essentially similar on all the tarsi. Proclaw of the right

first leg with five teeth on the retrolateral face and a basal one on the prolateral side near the base; retroclaw with five teeth on the prolateral face and a basal one on the retrolateral side. Palpus as illustrated in figures 28 and 29.

Abdomen dusky brown above, clothed with black hairs. Spinnerets four, the one-jointed medians, 0.70 mm. long, separated by their width, the large lateral spinnerets three-jointed, the basal joint, 1.25 mm., the median, 0.70 mm., and the distal joint, 0.50 mm. long.

**TYPE LOCALITY.**—Male holotype from Sabino Basin, Santa Catalina Mountains, Arizona, 3800 feet, July 8–12, 1916 (Dr. F. E. Lutz), in the collection of The American Museum of Natural History.

#### **BOTHRIOCYRTUM SIMON**

*Bothriocyrtum* SIMON, 1891, Act. Soc. Linn., Bordeaux, p. 314.

**GENOTYPE.**—*Cteniza californica* Cambridge.

#### **Bothriocyrtum californicum (Cambridge)**

Figures 32 to 37

*Cteniza californica* CAMBRIDGE, 1874, in Moggridge, 'Harvesting Ants,' etc., Suppl., p. 260, Pl. xv, fig. B.—McCOOK, 1893, 'American Spiders,' III, Pl. xxix, fig. 8.

*Bothriocyrtum californicum* SIMON, 1891, Act. Soc. Linn., Bordeaux, p. 315; 1892, 'Hist. Nat. Araignées,' I, p. 96.—SMITH, 1908, Ann. Ent. Soc., America, I, p. 214.

**MALE.**—Total length, including the chelicerae, 21.50 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	8.95		5.25	1.25	3.80	8.70 mm.
Width	8.30	5.50	4.60	1.70	1.10	7.10 mm.

Pars cephalica dark reddish brown, the head portion darker, the whole carapace smooth for the most part, the sutures deep, well marked, the cervical groove a deep procurved semilunar depression. Clothing of the carapace sparse, the margins of the pars thoracica with black hairs and strong erect black spines which are most conspicuous at the caudal end. Carapace slightly longer than broad, very broad in front, the width of the head at the second eye row about three-fourths the greatest width of the carapace. Pars thoracica convex, with conspicuous grooves at the position of the radiating streaks, the margins turned up to form a shallow trench along the margin. Pars cephalica moderately elevated, as seen from the side evenly declining caudally to the cervical groove, from above triangular in outline, the sides subequal. Cervical groove a deep transverse semilunar procurved depression, 1.50 mm. in width, about three-sixteenths of the width of the carapace at that point, situated back eleven-eighteenths of the total length of the carapace. Outline of the carapace as in figure 34.

Eyes on a low tubercle which occupies about one-third the width of the head at the second eyes (9/24). Clypeus subhorizontal, gently sloping forward, convex as seen from the side, scarcely as long as the eye group, with eight small spines in front of the anterior median eyes, with three larger spines just in front of the interval between the medians, the caudal one much larger. Eye tubercle with eight spines be-

tween the posterior median eyes. Ratio of the eyes: ALE:AME:PLE:PME = 62:40:38:25. First row of eyes procurved as seen from above, the medians separated by their short diameter, half as far as from the lateral eyes. Eyes of the second row

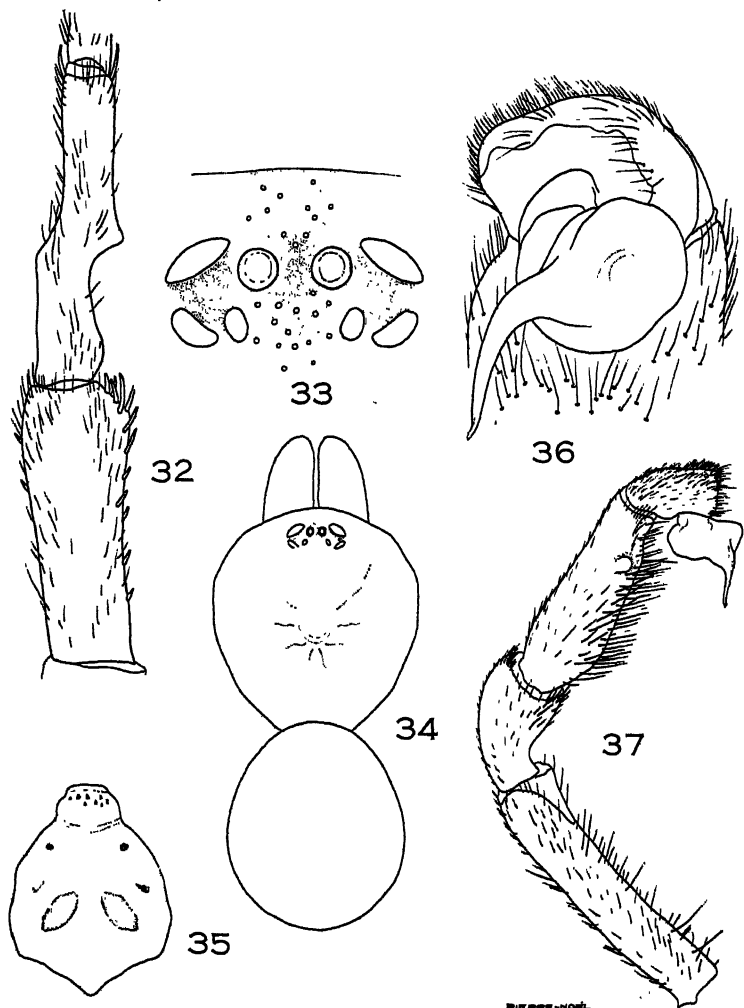


Fig. 32. *Bothriocyrtum californicum* (Cambridge), tibia and metatarsus of first right leg, dorsal view.

Fig. 33. Idem, eyes of male.

Fig. 34. Idem, carapace and abdomen of male, dorsal view.

Fig. 35. Idem, sternum of male.

Fig. 36. Idem, tarsus and bulb of male palpus, ventral view.

Fig. 37. Idem, male palpus, retrolateral view.

straight, the medians oval, separated by less than four diameters (94/25), one-half their short diameter from the laterals. Median ocular quadrangle broader than long (26/17), narrowed in front (26/18). Curvature of eyes and arrangement essentially as in figure 33.

Sternum longer than broad, evenly clothed with short black hairs, those on the margins more numerous and longer, with six sigilla, a large median pair between the second and third coxae which are separated by their short diameter, a very small pair opposite the second coxae, and a small round pair opposite the first coxae, these last mentioned sigilla very small and inconspicuous (Fig. 35). Labium broader than long, set with black hairs, the distal end with eight small cusps. Maxilla about twice as long as broad, clothed with black hairs, the prolateral side with a thick band of pale hairs, the base with a group of about twenty black cusps near the prolateral side. Chelicera nearly as broad as long as seen from the side, flat on the prolateral surface, convex retrolaterally and distally, armed with stiff black hairs and spines, the rastellum well developed, a strong black process armed with stout black spines. Promargin of the chelicera armed with seven very unequal teeth, the retromargin with five smaller teeth which are more widely separated, the groove itself with eight small denticles.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	8.80	4.25	5.90	6.20	2.60	27.75 mm.
II	8.10	3.80	5.50	6.00	2.50	25.90 mm.
III	6.70	3.35	4.70	5.00	2.50	22.25 mm.
IV	8.80	3.80	5.80	7.10	3.50	29.00 mm.
Palp	7.25	3.35	5.20		2.25	18.05 mm.

Leg formula, 4123. Legs concolorous with the carapace, the first rather sparsely spinose, the femur five times as long as broad, the tibia two and one-half times as long as broad, widened apically and armed with a cluster of six stout black spines on the retrolateral side, which is followed by eleven smaller retrolateral spines, the prolateral surface with five small black spines in the apical half. First metatarsus about three times as long as broad, narrow basally, curved, with a conspicuous bend near the middle, the retrolateral side with a strong tubercle. First tibia and metatarsus as figured (Fig. 32). First tarsus with a thin covering of short hairs and rows (4-2-1-2) of short black spines. Other legs normal in form, the last two tarsi scopulate beneath. Details of the palpus as in figures 36 and 37. Claws three, the median one small, the paired claws similar, with teeth in a single series. First and second proclaws and retroclaws with a tooth at the base, a much larger one distad of it, and four very small ones in a distal row, the denticles occupying three-fifths of the length of the claw. Third and fourth proclaws and retroclaws with two subequal teeth at the base but lacking the distal denticles.

Abdomen gray to brown, clothed with black hairs. Spinnerets four, the one-jointed medians separated by half their width, the very large lateral spinnerets three-jointed (basal joint, 1.10 mm., median, 0.50 mm., and distal joint, 0.60 mm. long), separated by their width.

TYPE LOCALITY.—California (Cambridge, 1874).

RECORDS.—Los Angeles, California, December 5, 1929, male and female (G. Grant). Inglewood, near Los Angeles, California, June 17, 1931, females (F. E. Lutz).



# AMERICAN MUSEUM NOVITATES

Number 885

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

October 13, 1936

THREE PARTIALLY AMBICOLORATE FOUR-SPOTTED  
FLOUNDERS, *PARALICHTHYS OBLONGUS*, TWO EACH WITH  
A HOOKED DORSAL FIN AND A PARTIALLY ROTATED EYE

BY. E. W. GUDGER AND F. E. FIRTH

## INTRODUCTION

For a number of years, Gudger has been studying abnormalities in teleostean fishes, and particularly color, eye and dorsal fin anomalies in flatfishes—Heterosomata. Numbers of these specimens have been contributed to the collections of the American Museum by Firth. As an assistant in the U. S. Bureau of Fisheries, detailed as a collector of biological data at the fish piers of Boston and Gloucester (Mass.), New York, and Norfolk (Va.), he has been able to enlist the interest and good will of the fishermen, captains and crews, in bringing in abnormal and other unusual fishes. The collections of the Museum have profited by Firth's exceptional opportunities. Some of his latest contributions form the basis of this joint paper.

Our material consists of four specimens: one entirely normal, to serve as a standard of comparison, and the three partial ambicolorates which are described herein. These fish were taken 50–60 miles southeast of Chesapeake Light Vessel, which lies about 12 miles out from the mouth of the Chesapeake Bay. These flounders come then from the Atlantic about opposite Currituck Beach, N. C.

The four-spotted flounder, *Paralichthys oblongus*, is a west Atlantic species previously recorded from Gloucester south to the New York region. However, the capture of the specimens under consideration, greatly extends the southern limit and establishes this in the western Atlantic at about the parallel of 35° 50' North.

Fish of this species run small, rarely exceeding 12 inches with about 14 inches as the maximum length, and one pound as the maximum weight. Since the four-spotted flounders extend out to the 100 fathom line, they are found in deeper water than most flounders. Ours were trawled in about 50–60 fathoms. They are small, thin and semitransparent fish.



## THE NORMAL FISH

Since our normal specimen was much battered in the net, and particularly since the upper side spots have almost entirely faded, it will not serve for an illustration. Instead we give here (Fig. 1) an outline sketch of the upper surface of a normal fish. As Fig. 1 shows, the four-spotted flounder is a sinistral or left-pointing fish which owes its name to the four prominent spots on its upper surface. These are in pairs above and below the lateral line. The anterior ones are near the dorsal and anal fins about midway between the tips of snout and tail. The other two spots are found on either side of the lateral line just anterior to the "small" of the tail and the hinder terminations of the dorsal and anal

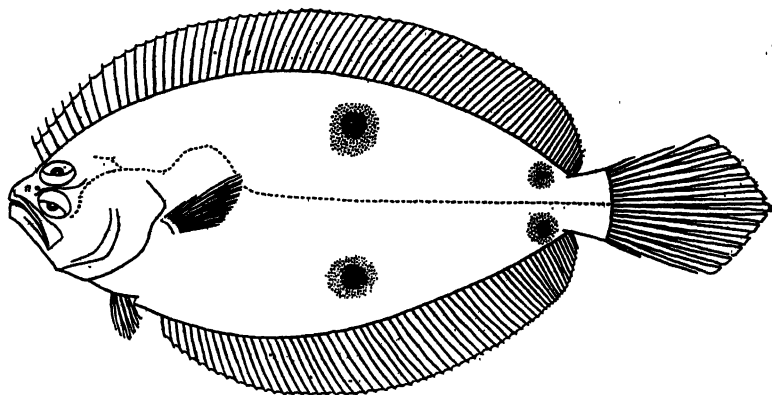


Fig. 1. Upper (left) surface of a normal four-spotted flounder, *Paralichthys oblongus*.

(After Norman, 1934.)

fins. The upper or rotated eye is on the left side well up toward but entirely across the dorsal ridge.

Our normal fish was taken by the Boston trawler, "Santina D.," Capt. Eugene Marino, about 50 mi. S. S. E. from Cape Henry, Va., in 50 fathoms late in January, 1936. It is the smallest of the entire lot, measuring 200 mm. (7.8 in.) to tip of tailfin. Its weight is 42.6 grams (1.5 oz.). Its upper surface is of the normal dark color, the posterior spots are fairly distinct, the anterior ones less so. These spots were none too clear in the just caught fish, and have faded badly in preservatives (formalin and alcohol). There is a faint bluish discoloration in the abdominal region, apparently due to some internal color. The whole under surface is an unmarred white.

I.—A PARTIALLY AMBICOLORATE SPECIMEN WITHOUT EYE  
OR DORSAL FIN ANOMALY

This fish, the largest of the group, measures, snout to tip of tail 240 mm. (9.5 in). Its weight is 99.4 grams (3.5 oz.). This four-spotted flounder is about an average specimen. It was taken on February 29, 1936, by Capt. Frank Favaloro of the trawler "Grace F.," in 50 fathoms, about 60 mi. S. S. E. of the Chesapeake Light Vessel. This is not the first interesting specimen for which the American Museum is indebted to Capt. Favaloro.

In form the upper surface is entirely normal. However, in the trawl-net the scales were partially scraped off, and thus it is difficult to distinguish all the spots. The one discoloration which is not clear is a



Fig. 2. Lower or right side of a partially ambicolorate four-spotted flounder. Note the perfect reproduction on the blind side of the four spots.

bluish inky area over the visceral region. This is in part due to color on the lower surface but mainly to something in the body cavity. The right or rotated eye is well clear of the dorsal crest. This and the anterior part of the dorsal fin are as entirely normal as are those of the fish shown in Fig. 1.

But, when one turns to the lower or right side (Fig. 2), an interesting and remarkable coloration is found. The caudal fin and about 2/5ths of the body are colored exactly as is the upper surface. A peninsula of dark color extends forward in the central region and a smaller peninsula extends to and includes the ventral one of the anterior pair of spots. An equal but isolated dark area surrounds the anterior dorsal spot. The dorsal fin is colored on its lower side forward to the region of the upper dark region and spot, but is white from this point on. The anal fin is

dark throughout its length save for a small white region about halfway between the lower forward spot and the vent.

Forward from this dark region, the whole under side of the fish is white save that in the visceral region there is externally a low inverted  $\wedge$ -shaped dark area, and above this a bluish internal discoloration. This bluish tinge is also noticeable under the upper part of the operculum and forward to the region of the eyes. Anterior to the inverted dark  $\wedge$ , the dark area covers the pelvic fin, extends along the left side of the throat and runs under the edge of the opercle up onto the base of the right pectoral fin. The bluish region under the dorsal fin in front of the anterior upper spot is due to the fin rays showing through the semi-transparent skin.

Most remarkable of all is the appearance and occurrence of the four spots on the lower, blind, white side. By pushing pins through the center of each spot on the upper surface, we find that, of these lower side spots, the hinder two spots and the anterior dorsal one are almost exactly under their correlative upper ones. The lower anterior one is somewhat smaller than the upper one and is slightly displaced forward. The spots are made up of dark centers and are surrounded by whitish rings.

Finally it may be pointed out that this partially ambicolorate flounder conforms to the rule for partial ambicoloration in heterosomate fishes. This is that, in ambicoloration, unless the whole lower body is colored like the upper and unless about 1/4th to 1/3rd of the head surface on the blind side is colored, the rotating eye will be found to have gone entirely past the dorsal crest and there will be no hooked anterior dorsal fin. It should be emphasized that to this general law, this specimen entirely conforms. The remarkable thing about this fish is the clear reproduction below of the four upper side spots which give the fish its name.

## II.—TWO PARTIALLY AMBICOLORATE SPECIMENS EACH WITH A PARTIALLY ROTATED EYE AND A HOOKED DORSAL FIN

A.—The smaller and less abnormal fish measures "over all" 225 mm. (8.8 in.). Its weight is 71 grams (2.5 oz.). Its history can only be given approximately. It was taken late in March, 1936, by an otter trawler in 50 to 60 fathoms E.  $\times$  S. of Chesapeake Lightship.

The upper surface is normal in its general coloration but badly faded. The spots have been almost entirely obliterated. Due to rough handling in the trawl, the scales have been rubbed off and the pigment has

badly faded in the alcohol. In the region of the visceral cavity there is the same bluish discoloration noted in the same region on the preceding fish. The abdomen is much swollen due to a heavy intake of food, and about midway of the base of the dorsal fin just on the anterior upper spot is an injury acquired in capture or handling. These are artifacts not abnormalities. But in the head region there are two anomalies: 1.—The right or rotating eye has barely cleared the dorsal crest—in fact its right or ventral edge is on the dorsal ridge and it is slightly visible from the blind side. 2.—Overhanging this incompletely rotated eye is a short hook in the anterior base of the dorsal fin, perhaps the shortest we have seen. These things are all clearly shown in Fig. 3.

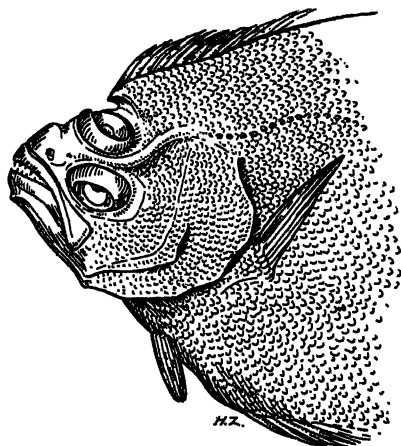


Fig. 3. Head only of the left side of a partially ambicolorate four-spotted flounder (IIA). The rotated eye is barely over the dorsal crest, and the anterior base of the dorsal fin has a small hook.

The lower, right, or blind side of this flounder (Fig. 4) is markedly like that of the other ambicolorate fish (Fig. 2). The tailfin and hinder  $2/5$ ths of the body are dark like that of fish No. I. This dark area extends farther forward above the lateral line than below. The four spots show very plainly on this fish. The anterior dorsal one is completely surrounded by the forwardly extending dark area. The ventral anterior spot is partially enclosed in a peninsula and its outer and lower dark rim in front has an embayment opening into the spot. The forward half of the body and fins is entirely white save a tiny bit of color in the gular region, a small dark patch in front of the base of the pectoral and a small streak extending on the fin from the base back on the center of the fin. There is a faint internal discoloration below and behind the operculum.

The spots on the upper side are badly faded as noted, but those on

the under side are wonderfully clear and sharp. Careful insertion of pins shows that the anterior upper large spot on the lower side is displaced obliquely backward and downward; but the anterior ventral spot is elevated about one-half its diameter above the center of the upper side spot. The hinder spots on the lower side are about squarely under the upper ones and are of about the same size. It is significant that the lower side spots are much clearer than the upper ones.

This fish absolutely violates what Gudger has found in a study of a number of specimens of partially ambicolorate flatfishes and in a review of all the known literature of ambicoloration. With a relatively small

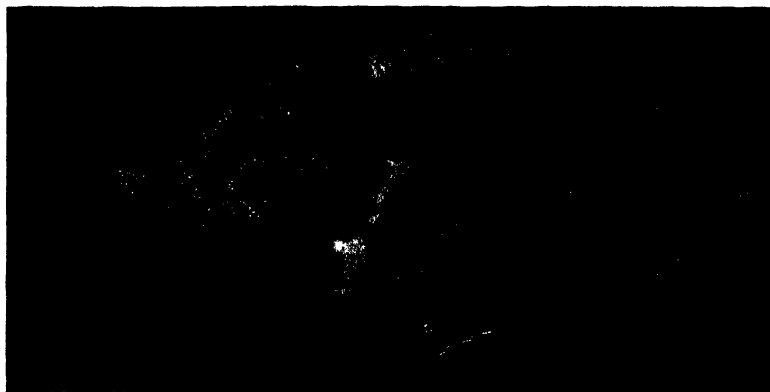


Fig. 4. The blind side of the partially ambicolorate four-spotted flounder (IIA) shown in Fig. 3. Note the spots and other coloration, the hooked dorsal fin and the rotated eye still visible from the lower side.

amount of lower side discoloration covering less than half the under side of the body, the right eye should be completely rotated and the anterior dorsal fin without trace of hook. On the contrary, as Fig. 4 shows, the right eye has stopped so nearly on the dorsal crest that the eyeball is just visible from the right or lower side, and overhanging this is a short hook in the anterior base of the dorsal fin. This hook, strange to say, has a dark point.

B.—The second fish of this division is the most abnormal of the lot as we shall see. From snout to tip of tail it measures 225 mm. (8.9 in.). It weight 71 grams (2.5 oz.). Seen from the upper or colored side the fish is entirely normal save for the lower side or rotated eye which is barely over the dorsal crest (farther over, however, than the rotating

eye in the fish IIA), and for the deep hook of the overhanging anterior dorsal fin (Fig. 5). The upper side has faded to a uniform brownish gray, and the spots have almost disappeared but there is found the same bluish discoloration in the visceral region that has been noted in the other three fish. The point of the hook is darker (Fig. 5) than that found in fish IIA (Fig. 3).

However, when one turns to the lower side (Fig. 6) a most anomalous situation is revealed. The anterior spots, which are so marked on our other two fish, are here lacking. The hinder ones are present but very much faded. By the use of pins, we found that these are squarely under the upper side spots. These spots are embedded in a dark area which extends forward a distance about equal to the length of the tail-fin, which

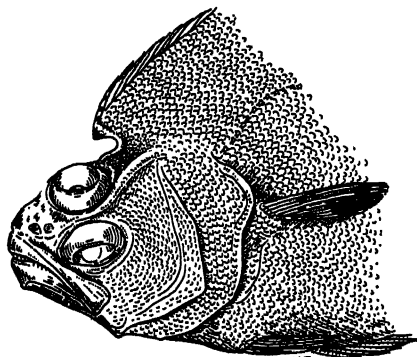


Fig. 5. Head only of left side of a partially ambicolorate four-spotted flounder (IIB). The right eye is farther over and the hook of the dorsal fin larger than are those shown in Fig. 3.

is also colored like the upper side. This colored region has a forward-pointing wedge-shaped area below the lateral line and just in front of it a dark island (not a spot) 7 mm. in diameter. The forward  $3/5$ ths of the dorsal fin is white. The anal fin is almost entirely white in its forward half. There is a narrow dark area extending from the tip of the pelvic fin forward over the gular region. There is also a dark area at the base of the pectoral and a tiny elongated spot on the fin. Everywhere else on the lower surface, the fish is white. The body and head from the base of tail to tip of snout is 7 in. long; of this the dark narrow tail region measures 1.5 in., the wider anterior 5.5 in. is the unchanged lower white surface.

That the eye is barely across the dorsal ridge (but farther across than in the preceding fish) is seen when one looks at Fig. 6. And far larger than that shown in Fig. 4 is the hook of the anterior dorsal fin

base. Note that the tip of this is colored. And all these things here accompany a nearly white lower surface of the fish.

With two exceptions, this is the most anomalous ambicolorate flatfish that either of us has seen or handled. The exceptions are two REVERSED almost totally ambicolorate halibuts, and a REVERSED ambicolorate flounder which will be described later. Each of us has handled a fair number of ambicolorate flatfishes and together we have described several. Gudger has studied and described others and has made a survey of all the cases of ambicoloration in the literature of which he has been able to get track—hundreds of fishes in all. Yet in none of these cases (studied in fish or in literature) has there been any case of an eye on or



Fig. 6. Lower side of another partially ambicolorate four-spotted flounder (IIB). Despite the small amount of ambicoloration (with two spots only), this fish has the rotated eye still slightly visible, and has a markedly hooked dorsal fin.

close to the dorsal crest with an overhanging or hooked dorsal fin UNLESS the whole under surface of the body proper was colored like the upper and unless AT LEAST 1/4th to 1/3rd of the under surface of the head was also colored.

For the phenomena found in fishes A and B no explanation can be offered at this time. Later, when the senior author has reviewed all the known cases of partial and complete ambicoloration and has studied the manner in which the eye moves over the dorsal crest, it may be possible to offer some explanation.

#### HISTORICAL NOTE

We have looked into the literature of the four-spotted flounder, but, save for one brief account now to be given, we have found no reference to anomalies. This is true even of J. R. Norman's 'Monograph

of the Flatfishes' (1934, I, pp. 79-80. London). The sole account is by D. H. Storer, in his 'History of the Fishes of Massachusetts' (1863, Mem. Amer. Acad. Arts and Sciences, VIII, pt. 2, p. 396). He wrote: "I have seen a single specimen [of the four-spotted flounder] having both sides dark-colored—and both bearing the peculiarly marked ocelli—with the exception of the head, which was, as usual, colorless beneath."

This was plainly a simple ambicolorate without any head deformity. This, we judge, because on a preceding page Storer had described and figured a completely ambicolorate "*Platessa oblonga*" with cyclopean eye and hooked dorsal fin. Hence he knew this condition. That this fish was our species is attested by his fine figure of the upper surface of a normal four-spotted flounder.





THE FAUNA OF THE SUNCHAL (OR MARGAS VERDES)  
FORMATION, NORTHERN ARGENTINA

By T. D. A. COCKERELL

Fossil insects were discovered near Sunchal in the Province of Jujuy, Argentina, by Mr. Geo. L. Harrington. The specimens were transmitted to the U. S. National Museum and were described in Proc. U. S. National Museum, LXVIII, Art. 1 (1925). In 1925 my wife and I visited the locality and got a much larger collection; the particulars will be found in Natural History, XXVII (1927), pp. 80-84; Nature, Nov. 14 (1925), pp. 711-712; Entomological News, XXXVII (1926), pp. 134-135; American Journal of Science, XI (1926), pp. 501-504; Science, LXII (1925), pp. 397-398; Annals and Magazine of Natural History, XVIII (October, 1926), pp. 317-322. The name Sunchal Formation was proposed in Natural History, 1927. The fauna, including the species now described, includes the following named species. Many other small beetle elytra, and various fragments of insects, have been left unnamed, as their description would not add anything of much value. I had not intended to describe so many of the weevils, but one of my former students, Mr. Chas. Wagner, made a study of them and gave preliminary descriptions of fifteen which he considered new; these were photographed (greatly enlarged) through the kindness of my colleague, Mr. Chas. R. Bitter. It would be interesting to compare these elytra minutely with those of the very rich South American weevil faunas, but materials for such a purpose are not available. The location of the specimens is indicated by letters, as follows: (A.) American Museum of Natural History; (B.) British Museum; (Y.) Yale University; (U.) U. S. National Museum.

## (1) FISHES

Callichthyidae: *Corydoras revelatus* Cockerell (B.)Poeciliidae: *Cyprinodon* (?) *primulus* Cockerell (A.)

## (2) COLEOPTERA (beetles)

Carabidae: *Carabites harringtoni* Cockerell (A.)*Carabites schueli* Cockerell (B.) (Y.)*Lebia harrelli* Cockerell (A.)Elateridae: *Elaterites microstictus* Cockerell (B.) (Y.)*Elaterites bruchi* Cockerell (B.)Chrysomelidae: *Chrysomalites danielis* Cockerell (B.)

- Cerambycidae: *Haruspex* (?) *defectus* Cockerell (B.)  
                   *Cerambycites wilmattae* Cockerell (B.)  
 Anthicidae: *Anthicus sepultulus* Cockerell (B.)  
 Cryptophagidae: *Cryptophagus sunchalensis* Cockerell (B.)  
 Cleridae: *Trichodes* (?) *stebingeri* Cockerell (A.)  
 Cantharidae: *Podabrus* (?) *santaritensis* Cockerell (A.)  
 Tenebrionidae: *Tenebrionites inclinans* Cockerell (U.)  
 Curculionidae: *Cossonus* (?) *devoratus* Cockerell (U.)  
                   *Otiorhynchites aterrimus* Cockerell (U.) (Y.)  
                   *Otiorhynchites crassus* Cockerell and Wagner (A.)  
                   *Anthonomus* (?) *sunchalensis* Cockerell (U.) (A.)  
                   *Curculionites harringtoni* Cockerell (U.) (Y.)  
                   *Curculionites jujuensis* Cockerell (U.) (A.)  
                   *Curculionites wielandi* Cockerell (U.)  
                   *Curculionites stebingeri* Cockerell (B.)  
                   *Curculionites angustior* Cockerell and Wagner (A.)  
                   *Curculionites sunchalicus* Cockerell and Wagner (A.)  
                   *Curculionites latiusculus* Cockerell and Wagner (A.)  
                   *Curculionites eustictus* Cockerell and Wagner (A.)  
                   *Curculionites microstictus* Cockerell and Wagner (A.)  
                   *Curculionites epistictus* Cockerell and Wagner (A.)  
                   *Curculionites megastictus* Cockerell and Wagner (A.)  
                   *Curculionites parastictus* Cockerell and Wagner (A.)  
                   *Curculionites magdalinus* Cockerell and Wagner (A.)
- (3) ORTHOPTERA (crickets)  
     Gryllidae: *Gryllites vociferans* Cockerell (B.)  
                   *Gryllites vocalis* Cockerell (A.)
- (4) DERMAPTERA (earwigs)  
     *Psalis pachyura* Cockerell (B.)
- (5) TRICHOPTERA (caddis-flies)  
     Molannidae: *Molanna* (?) *derosa* Cockerell (U.)
- (6) HEMIPTERA-HETEROPTERA  
     Coreidae: *Corizus* (?) *deflagratus* Cockerell (B.)
- (7) HEMIPTERA-HOMOPTERA  
     Flatidae: *Ormenis devinctus* Cockerell (B.)  
     Cixiidae: *Hypocixius obliquesens* Cockerell (B.)

There can be no doubt, I believe, that this is a Tertiary fauna, and it need not be early Tertiary. The matter is discussed in the articles above cited, but I now add some very interesting information and comments just furnished by Mr. Harrington (letters of April 19 and September 28, 1935).

You will doubtless be interested in knowing that the area within which the fossil beetles are found is far more extensive than I had imagined would be possible. I believe that the government (or Yacimientos Petroliferos Fiscales) geologist, Dr. Boehm, has found them as far north as the Lomas de Olmedo, nearly a degree of latitude to the north (and somewhat to the east) of Sunchal. During the past season

I found them at at least half a dozen places on the next two ranges east of the Sierra Santa Barbara, south almost to the Rio Juramento, or Rio Pasage. I believe that the Texas Co., geologists also found them on a tributary of the Rio or Arroyo Colorado (into which the Arroyo Sunchal waters eventually find their way), farther to the south than where we found them. There is now a fairly complete report on the areal geology by a Swedish geologist, Dr. Tor Hagerman. He takes exception to the age of the green shales which we have assumed, and I have wondered on reading over his report whether his interpretation is correct, or whether we were correct in assuming a Tertiary age. Could the beetles and fish you found be as old as upper Jurassic? In the underlying limestones I found a few specimens that may include two or three or possibly as many as five species of spiral turritelloid-like gastropods that may throw a little light on the subject, as there seems a more or less unbroken sequence upward from the limestone into the variegated shales. The limestone, however, is, in part, of shallow water origin, with ripple-marks and mud cracks, oölites, algal limestones, and conglomeratic limestones. (Written from Tartagal, April 19.)

(Regarding the turritelloid shells, see the discussion in Natural History, XXVII, p. 84.)

I worked over quite an extensive area during the past year, and obtained considerable data on the stratigraphic sequence, and found the beetle wings from the top of the heavy limestone, up through several hundred feet of the varied shales to the top of the green beds. I believe the Y. P. F. geologists found some even higher, in the overlying red shales.

I am very glad to have your statement that the fish is definitely Tertiary, as it confirms my own ideas, even though this means putting 10,000 or 20,000 feet of younger beds also in the Tertiary, which is by no means impossible, when we consider it as being the débris from eroded Andean uplift from which, over the crest of the folds, some 6000 feet or more has been removed. (Written from Palo Alto, Calif., September, 28.)

Mr. Eugene Stebinger writes (October 4, 1935) that beetle elytra were found by Mr. D. C. Harrell in the Province of Jujuy; "Location oo/cc 58 of upper Arroyo Santa Rita and oo/cd 27 of Quebrada 'El Griton'." This material has now been sent on. For the most part it is similar to that already recorded, but there are three very distinct new species of beetles, herewith described.

#### FISHES

##### *Cyprinodon* (?) *primulus*, new species

Figure 1, A. M. N. H. Cat. No. 24521

Very small broad-oval scales, about 1.5 mm. long, with six long basal radii, and none lateral or apical; circuli coarse; no trace of ctenoid structure, outline rounded, without angles; nucleus smooth, appreciably above the middle.

Ranges east of Sierra Santa Barbara, Prov. Jujuy, Argentina (Geo. Harrington). In addition to the type scales there are fragments of others on the same piece of rock. This is a poeciliid type of scale, and

is referred to *Cyprinodon* with doubt; I have not seen a *Cyprinodon* scale with so few radii. Probably it could be closely matched by the scales of some of the small South American Poeciliidae, material of which is not available. As preserved, the area which was exposed is brown, the concealed parts are pale.

There is also a fish-spine about 14 mm. long; it could just as well be one of the spines of the dorsal fin of *Percichthys antiquus* A. S. Woodward, 1898.

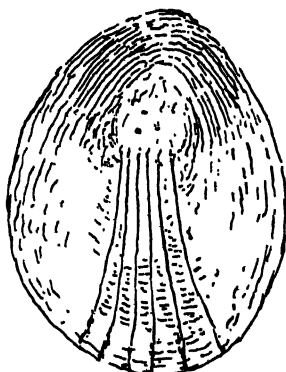


Fig. 1. *Cyprinodon* (?) *primulus*, new species.

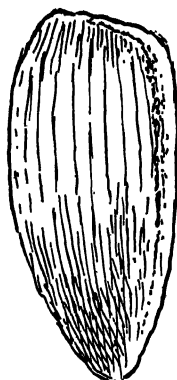


Fig. 2. *Carabites harringtoni*, new species.

#### BETTER

#### *Carabites harringtoni*, new species

Figure 2, A. M. N. H. Cat. No. 24522

Elytron about 10.5 mm. long and 5 broad; as preserved, dark brown without markings; humeral margin broad and straight, somewhat oblique; depressed lateral margin broad, its width near base about 1 mm.; elytron between outer margin and sublateral groove with eight fine striae, the intervals very wide except the outermost and innermost; no punctures.

Ranges east of the Sierra Santa Barbara, Prov. Jujuy, Argentina (Geo. L. Harrington). Readily known from *Carabites schueli* Cockerell, from the same formation, by its much greater size, but sharing with that species the broad and relatively short form. There is a general resemblance to the modern genus *Amara*.

#### *Lebia harrelli*, new species (Carabidae)

Figure 3, A. M. N. H. Cat. No. 24518

Elytra about 4.5 mm. long, width of the insect in abdominal region 3.5; elytra with the humeral region narrowly black, a broad black band across middle of elytron

(its width fully 1.3 mm.), and the apex broadly black; there is also a band along each inner margin, but its upper end is feebly developed, though it probably was entire in life.

The locality is given as oo/cd 27—(D. C. Harrell).

The pattern would do also for *Panagaeus*, but the broad form agrees with some *Lebia*. There is a certain resemblance to some Chrysomelidae, as *Phytodecta*.

***Trichodes* (?) *stebingeri*, new species (Cleridae)**

Figure 4, A. M. N. H. Cat. No. 24519

Elytron about 3.8 mm. long, similar to that of the living *T. ornatus* Say, but much smaller, the subapical light band lacking; the median band curved upward (basal) at its inner end, and on the costal side very broadly continuous with the sub-humeral band, which, as in *T. ornatus*, encloses a dark spot; no light spots near inner margin.

Collected by D. C. Harrell; oo/cd 27.

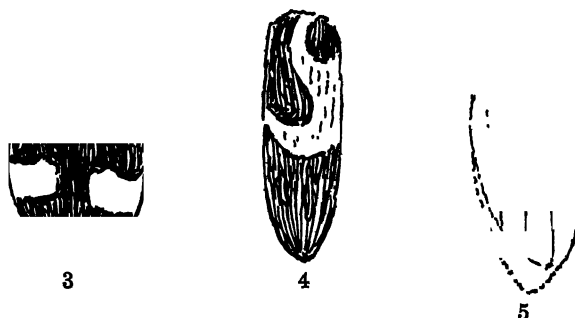


Fig. 3. *Lebia harrelli*, new species.

Fig. 4. *Trichodes* (?) *stebingeri*, new species.

Fig. 5. *Podabrus* (?) *santaritensis*, new species.

***Podabrus* (?) *santaritensis*, new species (Cantharidae)**

Figure 5, A. M. N. H. Cat. No. 24520

Elytron apparently about 4 mm. long, but apex not visible; very pale brownish, doubtless yellow in life; characterized by three parallel, widely spaced, strong raised lines, as in the modern *Podabrus*. It probably belongs to a different but related genus. There are two faint longitudinal rugulose lines between each pair of raised lines, but no trace of any cross ridges.

Collected by D. C. Harrell; oo/cd 27. About 3 mm. from the type of *Trichodes stebingeri*.

**Anthonomus (?) sunchalensis** Cockerell

Figure 16, A. M. N. H. Cat. No. 24516; Figure 18, A. M. N. H. Cat. No. 24517

Elytron about 5.4 mm. long and 2.4 wide; nine rows of punctures, with eleven punctures to the mm.

Sunchal (Cockerell). Specimen marked 18. Mr. Wagner had separated this as new, but it seems to me to belong to *A. sunchalensis*. I also place here the specimen marked 16.

**Otiorhynchites crassus** Cockerell and Wagner, new species

Figure 12, A. M. N. H. Cat. No. 24513

Elytron about 7 mm. long and 3.5 wide; nine rows of large punctures, three to one mm. Larger and more coarsely punctured than *O. aterrimus* Cockerell, from the same deposit.

Sunchal, Station 3 (Cockerell). Specimen marked 12.

**Curculionites angustior** Cockerell and Wagner, new species

Figure 11, A. M. N. H. Cat. No. 24512

Elytron about 3.1 mm. long, 1 mm. wide; five rows of punctures showing nine punctures to the mm.; the punctures are broad and set close together.

Sunchal, Station 2 (Cockerell). Specimen marked 11. It is proportionately narrower than in *C. jujuyensis* Cockerell, from the same deposit.

**Curculionites sunchalicus** Cockerell and Wagner, new species

Figure 14, A. M. N. H. Cat. No. 24515

Elytron about 3.7 mm. long, 1.9 wide; as preserved brown; nine rows of punctures, with ten punctures to the mm., the punctures very minute and set close together.

Sunchal, Station 3 (Cockerell). Specimen marked 14. Distinguished by its small size and broad form from other species in this deposit. It must have been a very robust beetle, such as *Tanysphyrus*.

**Curculionites latiusculus** Cockerell and Wagner, new species

Figure 8, A. M. N. H. Cat. No. 24507

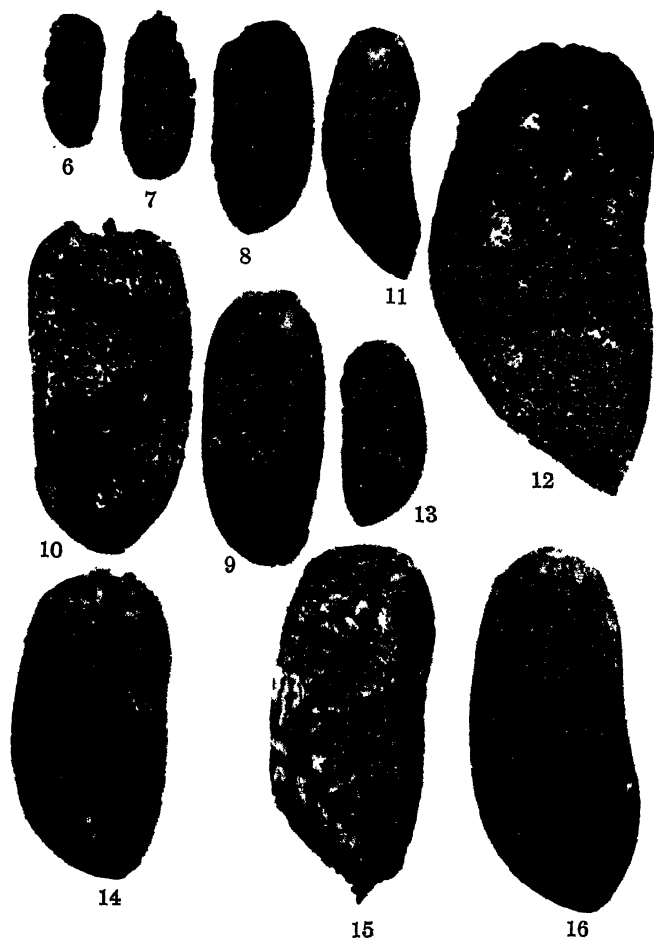
Elytron about 3 mm. long, 1.5 wide; dark brown as preserved; ten rows of punctures, with eight punctures to the mm.

Sunchal, Station 2 (Cockerell). Specimen marked 8. More robust than *C. jujuyensis* from the same deposit.

**Curculionites jujuyensis** Cockerell

Figure 7, A. M. N. H. Cat. No. 24506

Elytron about 2.25 mm. long, .9 wide; nine rows of punctures, with ten punctures to the mm.



- Fig. 6. *Curculionites parastictus* Cockerell and Wagner, new species.  
Fig. 7. *Curculionites jujuyensis* Cockerell.  
Fig. 8. *Curculionites latiusculus* Cockerell and Wagner, new species.  
Fig. 9. *Curculionites eustictus* Cockerell and Wagner, new species.  
Fig. 10. *Curculionites microstictus* Cockerell and Wagner, new species.  
Fig. 11. *Curculionites angustior* Cockerell and Wagner, new species.  
Fig. 12. *Otiorhynchites crassus* Cockerell and Wagner, new species.  
Fig. 13. *Curculionites parastictus* Cockerell and Wagner, new species.  
Fig. 14. *Curculionites sunchalicus*, Cockerell and Wagner, new species.  
Fig. 15. *Curculionites epistictus* Cockerell and Wagner, new species.  
Fig. 16. *Anthonomus* (?) *sunchalensis* Cockerell.



Sunchal (Cockerell). Specimen marked 7. Mr. Wagner had separated this out as new, but it is so like *C. jujuyensis* that I cannot satisfactorily separate it.

**Curculionites eustictus** Cockerell and Wagner, new species

Figure 9, A. M. N. H. Cat. No. 24508

Elytron about 3.5 mm. long, 1.5 wide; nine rows of punctures, with six punctures to the mm.

Sunchal, Station 2 (Cockerell). Specimen marked 9. The elytron is narrower than in *C. sunchalensis*; the beetle must have been considerably less robust. The punctures appear dark on a light ground.



Fig. 17. *Curculionites megastictus* Cockerell and Wagner, new species.

Fig. 18. *Anthonomus* (?) *sunchalensis* Cockerell.

**Curculionites microstictus** Cockerell and Wagner, new species

Figure 10, A. M. N. H. Cat. No. 24509

Elytron about 4 mm. long, width 2; nine rows of punctures with six punctures to the mm.; apex obtuse.

Sunchal, Station 2 (Cockerell). Specimen marked 10, 3.5 mm. from the type of *C. eustictus*. Very like *C. harringtoni* Cockerell, from the same deposit, but conspicuously smaller. It is dark brown as preserved, much darker than *C. eustictus*.

**Curculionites epistictus** Cockerell and Wagner, new species

Figure 15, A. M. N. H. Cat. No. 24510

Elytron about 4.5 mm. long, 2 wide; nine rows of punctures, with seven punctures to the mm.; apex conspicuously more attenuate than in *C. microstictus*.

Sunchal, Station 2 (Cockerell). Specimen marked 15, about 8 mm. from the type of *C. microstictus*.

**Curculionites megastictus** Cockerell and Wagner, new species

Figure 17, A. M. N. H. Cat. No. 24511

Elytron about 4.75 mm. long and 2.25 wide; nine rows of punctures, with five punctures to the mm. The punctures are much larger than on *C. microstictus*.

Sunchal, Station 2 (Cockerell). Specimen marked 17, 3 mm. from the type of *C. microstictus*.

**Curculionites parastictus** Cockerell and Wagner, new species

Figure 13, A. M. N. H. Cat. No. 24514

Elytron as preserved pale brown; 3.30 mm. long and 1.4 wide; nine rows of punctures, with eight punctures to the mm. Very like *C. sunchalensis*, but narrower.

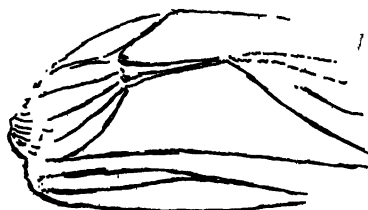
Sunchal (Cockerell). Specimen marked 13.

**Curculionites magdalinus** Cockerell and Wagner, new species

Figure 6, A. M. N. H. Cat. No. 24505

Elytron about 1.5 mm. long, .7 wide; eight rows of extremely small punctures, thirteen punctures to the mm.; it is parallel-sided, with very obtuse apex.

Sunchal (Cockerell). Specimen marked 6. Much smaller than *C. jujuyensis*. It is suggestive of the modern genus *Magdalis*.

Fig. 19. *Gryllites vocalis*, new species.

## CRICKET

**Gryllites vocalis**, new species

Figure 19, A. M. N. H. Cat. No. 24523

Male; the part of tegmen visible 7 mm. long and 4 broad, but the vertical portion with oblique veins is not preserved; as preserved, the wing is colorless. The venation is shown in the figure.

The name *Gryllites* is used to cover fossil Gryllidae which cannot be referred to particular genera. The present insect is not a *Gryllus*, but is more like *Gryllotalpa*, or even *Nemobius*.

Ranges east of Sierra Santa Barbara, Prov. Jujuy, Argentina (Geo. L. Harrington). Easily known from *Gryllus vociferans* Cockerell, from the same formation, by the greater size and differences in venation.



# AMERICAN MUSEUM NOVITATES

Number 887

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

October 15, 1936

## A PLEISTOCENE FLORA FROM FAIRBANKS, ALASKA

BY RALPH W. CHANEY,<sup>1</sup> AND HERBERT L. MASON<sup>2</sup>

### INTRODUCTION

The material here described was collected in 1929 by Mr. Peter Karsen, near Fairbanks, Alaska. This expedition was under the joint auspices of Alaska College and The American Museum of Natural History, and the valuable mammalian fossils which were its principal objective are being studied by Mr. Childs Frick. The writers wish to express to Mr. Frick and Dr. C. E. Bunnell of Alaska University their appreciation of the opportunity he has given them to study the plant collections.

The plants occur at several localities, all of which are in the vicinity of Fairbanks. Due to burial in frozen muck, their preservation is excellent, with structures little if any altered.

Pleistocene floras of western North America are well known only from the coast of California. This is the first record of the occurrence of a considerable group of species from Alaska. The association of these plants with the remains of Pleistocene mammals is of especial importance, since it makes possible a more accurate definition of the physical conditions. The presence of numerous specimens of well-preserved fungi adds interest to the Fairbanks flora, since these organisms are rarely preserved in the fossil record.

All of these specimens are part of the collections of The American Museum of Natural History. The numbers of figured specimens are indicated in the descriptions of the figures.

### COMPOSITION OF THE FLORA

Of the 27 plants recognized, all except two can be placed in modern genera. All of the remainder are either referred definitely to modern species, or a resemblance to them is indicated. Following is a list of the plants included in the flora:

Phylum Thallophyta  
Class Fungi  
Order Lycoperdales

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<sup>1</sup> Carnegie Institution of Washington, University of California.

<sup>2</sup> University of California.

- Family Lycoperdaceae
  - Bovista plumbea* Pers.
- Order Polyporales
  - Family Polyporaceae
    - Fomes applanatus* (Pers.) Gill.
    - Fomes fomentarius* (L.) Gill.
    - Fomes pinicola* (Schwehd.) Cooke
    - Ganoderma lucidum* (Leyss.) Karst
- Phylum Spermatophyta
  - Class Gymnospermae
    - Order Coniferales
      - Family Pinaceae
        - Picea glauca* Voss.
  - Class Angiospermae
    - Subclass Monocotyledonae
      - Order Graminales
        - Family Cyperaceae
          - Carex*(?) sp. A
          - Carex*(?) sp. B
          - Eriophorum* sp. A
          - Eriophorum* sp. B
    - Subclass Dicotyledonae
      - Order Salicales
        - Family Salicaceae
          - Salix arctica* Pall.
          - Salix glauca* L.
          - Salix daphnoides* Vill.
          - Salix reticulata* L.
          - Populus tremuloides* Michx.
      - Order Fagales
        - Family Betulaceae
          - Betula alaskana* Sarg.
          - Betula glandulosa* Michx.
      - Order Caryophyllales
        - Family Caryophyllaceae
          - Arenaria sajanensis* Willd.
          - Silene acaulis* L.
          - Silene* sp.
      - Order Ranales
        - Family Ranunculaceae
          - Ranunculus* cf. *eschschoitzii* Schlecht.
      - Order Rhodales
        - Family Cruciferae
          - Draba fladnizensis* Wulf.
      - Order Rosales
        - Family Rosaceae
          - Potentilla villosa* Lehn.
          - Potentilla* sp.

## Order Primulales

## Family Primulaceae

*Androsace villosa* L.

## Order Polemoniales

## Family Polemoniaceae

*Phlox* cf. *sibirica* L.

## Order Asterales

## Family Compositae

*Taraxacum ceratophorum* (Led.) D.C.

More than half of the fossil flora as now known is made up of herbaceous species. There are 8 species of trees or shrubs, with the latter the more common growth form in the latitude of Fairbanks. Of the 5 species of fungi, 4 are parasitic upon woody plants. Following is the classification according to habit:

HERBS	TREES OR SHRUBS	FUNGI
<i>Androsace villosa</i>	<i>Betula alaskana</i>	<i>Bovista plumbea</i>
<i>Arenaria sajanensis</i>	<i>Betula glandulosa</i>	<i>Fomes applanatus</i>
<i>Carex</i> (?) sp. A	<i>Picea glauca</i>	<i>Fomes fomentarius</i>
<i>Carex</i> (?) sp. B	<i>Populus tremuloides</i>	<i>Fomes pinicola</i>
<i>Draba fladnizensis</i>	<i>Salix arctica</i>	<i>Ganoderma lucidum</i>
<i>Eriophorum</i> sp. A	<i>Salix daphnoides</i>	
<i>Eriophorum</i> sp. B	<i>Salix glauca</i>	
<i>Phlox</i> cf. <i>sibirica</i>	<i>Salix reticulata</i>	
<i>Potentilla villosa</i>		
<i>Potentilla</i> sp.		
<i>Ranunculus</i> cf. <i>eschsoltzii</i>		
<i>Silene acaulis</i>		
<i>Silene</i> sp.		
<i>Taraxacum ceratophorum</i>		

The trees and shrubs, represented largely by leaves, wood and fruiting structures, appear to have been brought into the sites of deposition by wind or water, and to have accumulated in the bog in much the same way as are corresponding structures in Tertiary deposits. The fungi were doubtless accumulated in a similar manner. It may be supposed that the trees on which they grew were situated close to the sites of deposition. Most of the remains of herbaceous plants are a part of the caches of rodents, and their abundance in our collections is due to this selective agency, and to the fact that continuous freezing has preserved them ever since their time of accumulation. Figure 11 shows a mass of seeds,  $5 \times 4 \frac{3}{4} \times 3$  inches in dimensions, which represents a portion of one of these caches.

## PHYSICAL INDICATIONS

There is little to indicate that the climate differed measurably from that of today during the time the plants of the Fairbanks flora were being accumulated. Of the species which are still known to be living, all are typically boreal or alpine in distribution at the present time, and with few exceptions are known to occur in the vicinity of Fairbanks. Two of the willows, *Salix arctica* and *S. reticulata*, occupy more exposed situations along the coast or in the mountains, but their absence from the modern flora can hardly be explained as due to climatic change. The rarity of these species in the fossil record is suggestive of a habitat somewhat removed from the sites of deposition in the Fairbanks area, and it is probable that their leaves were transported down from higher levels.

The herbs commonly occur in boreal America where the ground remains frozen throughout the year, thawing only near the surface during the summer. The capsules and seeds which make up the record are more perfectly preserved than those of the California Pleistocene, in which freezing has not been a factor in preservation. It is reasonable to assume that low subsoil temperatures have characterized this region almost continuously since the plant remains were accumulated.

The gopher holes in which most of the seeds occur have been dug many feet into muck which is now frozen. Since rodents at the present time do not appear to be able to burrow into permanently frozen ground, it seems possible to conclude that the ground was not as extensively frozen when the seeds were placed in the burrows as is now the case. Either the permanently frozen soil was farther below the surface than at present, or it was only seasonal during the time the plants were accumulated. Fluctuation of the level of the zone of frost, due to variations in temperature or precipitation, is consistent with evidence of climatic changes at lower latitudes during the Pleistocene.

## AGE OF THE PLANT REMAINS

On the basis of the species represented in the Fairbanks flora, the age of the deposits in which it occurs might be considered to be Recent. The only common species which has not been identified in the living vegetation of Alaska is an indeterminate *Silene*, whose capsules are among the most abundant fossils in the flora. This species can not in itself be considered to indicate any great geologic age, in view of its association with so many others which are still living.

The association of the plants with extinct fossil mammals,<sup>1</sup> including

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<sup>1</sup> Frick, 1930, Jour. Amer. Mus. Nat. Hist., XXX, No. 1, pp. 71-80.

such typical Pleistocene species as *Aenocyon dirus alaskensis*, *Arctodus yukonensis*, *Bison crassicornis*, *Bootherium sargenti*, *Camelops*, *Equus alaskae*, *Felix atrox alaskensis*, *Mammonteus primogenius*, *Mastodon americanus* and *Symbos tyrelli*, is the only indication of their antiquity. This involves the assumption that the plants are contemporaneous with the mammals, an assumption which appears to be sound on the basis of the field evidence now at hand.

In this connection it is of interest to note that three genera of the Fairbanks flora, *Betula*, *Carex* and *Ranunculus*, have been reported by Sukachoff<sup>1</sup> in the stomach contents of a mammoth. Twelve other species of plants, all boreal in modern distribution, were included in the food of this elephant, whose remains were found on the Berezovka River, in the Province of Yucutsk, Siberia.

Comparison of the Fairbanks flora with other Pleistocene floras in western America brings out an absence of critical relationship, which might be expected in view of their difference in latitude. However, it may be recorded that the Tomales flora,<sup>2</sup> from coastal California north of San Francisco Bay, includes the following Fairbanks genera or species: *Carex* sp., *Fomes applanatus*, *Picea sitchensis* and *Salix* sp. The San Bruno flora,<sup>3</sup> from coastal California south of San Francisco Bay, includes *Carex* sp. and *Silene* sp. The climate on the California coast during the Pleistocene was cool temperate, and the forest was dominated by closed-cone pines and other plants which have survived in suitable localities in areas adjacent to the fossil localities. The difference between the vegetation from California to Alaska during the Pleistocene was of the same order as at the present time, and was consistent with their difference in latitude.

Most of the technical distinctions between deposits of Pleistocene and Recent age lose their sharpness in a region such as Fairbanks, whose present climate might be considered to be typically Pleistocene. The absence from the region at the present time of most of the mammalian types recorded in the frozen muck, and the extinction of most or all of the species, is the only evidence of a considerable interval of time since the plants associated with them were buried and preserved.

#### SYSTEMATIC DISCUSSION

Since almost all of the plants recognized in the Fairbanks flora are referred to modern species, it is not considered necessary to describe

<sup>1</sup> 1914, 'Scientific Results of the Expedition sent by the Academy of Sciences to the Beresovka River for the Investigation of the Mammoth found in 1901,' Russian Acad. Sci., III.

<sup>2</sup> Mason, 1934, Carnegie Inst. Wash., Pub. 415, No. 4, pp. 81-179.

<sup>3</sup> Potbury, 1932, Carnegie Inst. Wash., Pub. 415, No. 2, pp. 25-44.



them in this report. The structures preserved, the localities where they occur and their modern distribution are considered below.

There are several types of seeds which have not as yet been recognized. It may be supposed that their absence from our list will not affect our conclusions in any important respect.

Acknowledgment is due to Dr. Carleton R. Ball, formerly of the University of California, for his assistance in the determination of the species of *Salix*, and to Dr. Lee Bonar, of the University of California, for his determination of the fungi. Both of the authors have had field experience in Alaska, and the junior author has collected practically all of the species represented in the fossil flora in the course of his journey along the coast of Alaska to Point Barrow.

#### FUNGI

##### ***Bovista plumbea* Pers.**

Figures 12, 21 and 22

The preservation of this puffball has been due to the thick, leathery membrane characteristic of *Bovista*. The specimen, flattened by pressure, is 2.3 cm. in diameter. Inside the peridium there are preserved tapering capillitia which are also indicative of this genus. Associated with these are abundant spores, bearing elongate pedicels which characterize *B. plumbea*.

OCCURRENCE.—Head of Goldstream, Buried Forest.

##### ***Fomes applanatus* (Pers.) Gill.**

Figures 3 and 7

This species is represented by a sporophore which has suffered no apparent alteration, as is the case with the species of bracket fungi which follow. It is world-wide in distribution, occurring on trunks of angiosperms most commonly, and rarely on coniferous wood.

OCCURRENCE.—Lillian Creek, Livingood.

##### ***Fomes fomentarius* (L.) Gill.**

Figure 4

This fungus is common on the trunks of various angiosperms, but the host in the case of our specimen was *Betula*, as shown by the fragments of birch bark still attached to it.

OCCURRENCE.—Head of Goldstream, Buried Forest.

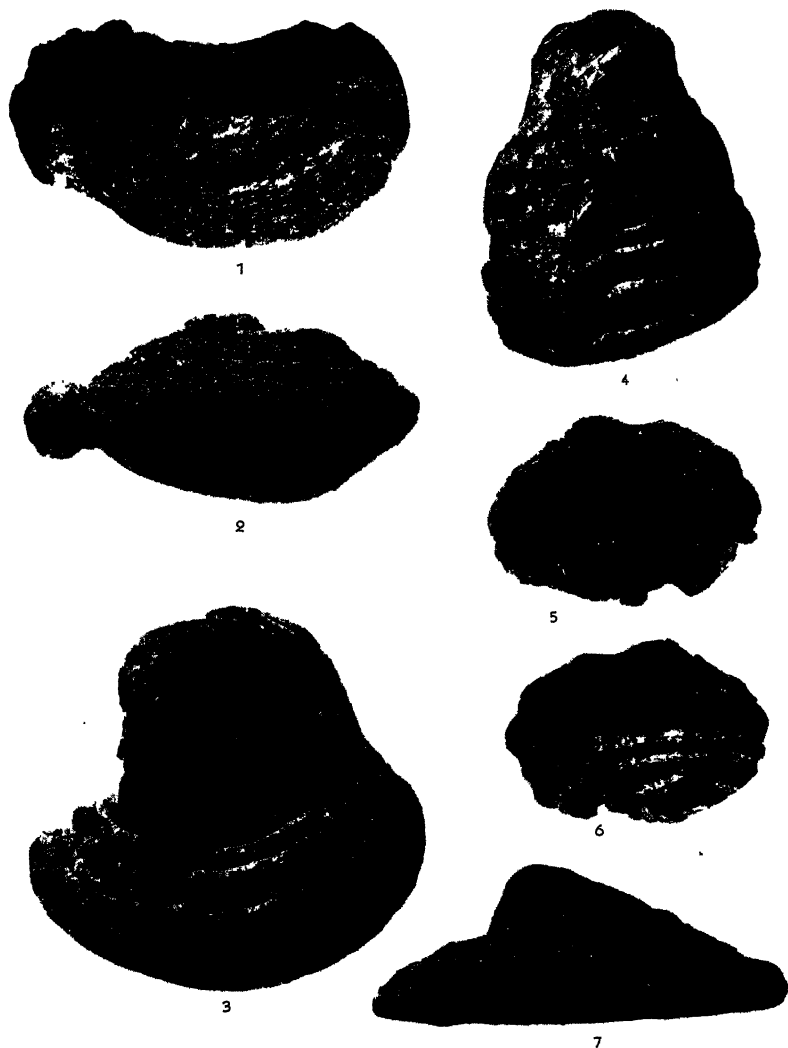


Fig. 1. *Fomes pinicola* (Schwehd.) Cooke. Upper surface. Plesiotype. A.C.-F:A.M.30851.

Fig. 2. *Fomes pinicola* (Schwehd.) Cooke. Side view. Plesiotype. A.C.-F:A.M.30851.

Fig. 3. *Fomes applanatus* (Pers.) Gill. Upper surface. Plesiotype. A.C.-F:A.M.30848.

Fig. 4. *Fomes fomentarius* (L.) Gill. Showing the surface attached to the host when *in situ*. Plesiotype. A.C.-F:A.M.30850.

Fig. 5. *Ganoderma lucidum* (Leyss.) Karst. Showing the surface attached to the host when *in situ*. Plesiotype. A.C.-F:A.M.30853.

Fig. 6. *Ganoderma lucidum* (Leyss.) Karst. Side view. Plesiotype. A.C.-F:A.M.30853.

Fig. 7. *Fomes applanatus* (Pers.) Gill. Side view. Plesiotype. A.C.-F:A.M.

**Fomes pinicola** (Schwehd.) Cooke

Figures 1 and 2

This species is common over the northern hemisphere, but is generally restricted to coniferous trees.

OCCURRENCE.—Head of Goldstream.

**Ganoderma lucidum** (Leyss.) Karst

Figures 5 and 6

Occurring in both hemispheres, this species is largely confined to angiosperms.

OCCURRENCE.—Head of Goldstream.

## CONIFER

**Picea glauca** Voss.

Figures 8, 9 and 10

Widely distributed in higher latitudes, this species approaches the shores of the Arctic Ocean near Bering Strait, and is present in the Fairbanks area today. A large tree at the southern end of its range, it is limited to a meter in height in exposed situations at the North.

A small branch bearing leaves, as well as numerous wood fragments and cones have been preserved. The latter still contain well-preserved seeds.

OCCURRENCE.—Fairbanks; Cleary Creek, 1 1/2 miles below Cleary, 15 feet below surface.

## MONOCOTYLEDONS

**Cyperaceae**

All of the seed collections contain abundant achenes of *Carex* and *Eriophorum*. Whereas certain of these can be definitely designated as *Eriophorum*, there are others which may be either *Eriophorum* or *Carex*. There are still others which appear to be *Carex* and are referred with doubt to this genus. The presence of numerous species of both genera in boreal regions at the present time makes the reference of our material to *Carex* and *Eriophorum* wholly consistent.

**Carex** (?) sp. A

Figures 43 and 44

**Carex** (?) sp. B

Figures 45 and 46

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below



Fig. 8. *Picea glauca* Voss. Foliage. Plesiotype. A.C.-F:A.M.30855.  
 Fig. 9. *Picea glauca* Voss. Seed. Plesiotype. A.C.-F:A.M.30856.  
 Fig. 10. *Picea glauca* Voss. Cone. Plesiotype. A.C.-F:A.M.30858.  
 Fig. 11. Seed mass from a rodent burrow. The large capsules are *Silene* sp.  
 The small seeds represent the remains of an undetermined fruit. A.C.-F:A.M.  
 30876.

surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

**Eriophorum** sp. A

Figure 47

**Eriophorum** sp. B

Figure 48

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

DICOTYLEDONS

**Salix arctica** Pall.

Figures 15 and 18

This species, represented by the two leaves figured, was probably not common along the valleys where most of the plants represented in this collection lived. At the present time it ranges along the Arctic coast and in the more exposed mountain habitats. Occurring as a low shrub, the opportunities for wide dissemination of its leaves are less than in the case of taller willows. Its comparative rarity in the fossil record may be considered to be due to its low stature, and the remoteness of its habitat from sites of deposition.

OCCURRENCE.—Fairbanks.

**Salix daphnoides** Vill.

Figure 13

Except for a limited range into British Columbia and the Yukon Territory, *Salix daphnoides* Vill. is confined to Alaska where it is widely distributed. It extends along the coast from the Alaskan peninsula to the Bering Sea. In the interior it is associated with *Betula alaskana*.

OCCURRENCE.—Head of Goldstream, Buried Forest.

**Salix glauca** L.

Figure 14

A few leaves represent this species which today is the most common Alaskan willow. It is widely distributed throughout Alaska except along the Arctic coast, extending into the Yukon Territory and British Columbia.

At Savage River Camp in Mt. McKinley National Park, *S. glauca* occurs



13



14



15



16



17



18



19



20

Fig. 13. *Salix daphnoides* Vill. Plesiotype. A.C.-F:A.M.30866.

Fig. 14. *Salix glauca* L. Plesiotype. A.C.-F:A.M.30867.

Fig. 15. *Salix arctica* Pall. Plesiotype. A.C.-F:A.M.30864.

Fig. 16. *Betula glandulosa* Michx. Plesiotype. A.C.-F:A.M.30871.

Fig. 17. *Salix reticulata* L. Plesiotype. A.C.-F:A.M.30868.

Fig. 18. *Salix arctica* Pall. Plesiotype. A.C.-F:A.M.30865.

Fig. 19. *Populus tremuloides* Michx. Showing tooth marks of beaver.  $\times 1/2$ .

with *Picea glauca*, *S. daphnoides* and *S. reticulata*. It is commonly associated with *S. daphnoides* and *Betula alaskana* along streams in less exposed regions such as the valley of the Tanana at Fairbanks.

OCCURRENCE.—Head of Goldstream, Buried Forest.

***Salix reticulata* L.**

Figure 17

A single leaf in the collections exhibits the diagnostic foliar characters of *Salix reticulata* L. The distribution and habitat requirements of this species correspond with those of *Salix arctica*; both range along the coast from Norton Sound southward, occasionally extending into higher mountains. *Salix reticulata* has not been recorded from the modern flora at Fairbanks, but occurs in the adjacent mountains. Herbarium specimens indicate its presence at Healy, Alaska (1368 feet altitude), and at Savage River Camp (2650 feet) in association with *Salix daphnoides* and *S. glauca*.

OCCURRENCE.—Head of Goldstream, Buried Forest.

***Populus tremuloides* Michx.**

Figure 19

Widespread over the whole of the North American continent, the aspen is a common tree along the Yukon river, and is found in the Fairbanks region.

It is represented in our collections by several pieces of wood, representing branches or small trees. Two of the specimens have been chewed by beavers.

OCCURRENCE.—Cleary Creek, 1 1/2 miles below Cleary.

***Betula alaskana* Sarg.**

Figure 20

A number of leaves represent *Betula alaskana*. This species, regularly associated with *Picea glauca* in the mountains up to timber line, is also found bordering the rivers of Alaska. In the Kenai Peninsula Plateau where it grows most abundantly, it extends to the shores of Turnagain Arm, up Shushitna River and its tributaries, and to the west side of Cook Inlet. Although rare on the seaward side of the coast mountains, it is common in the interior valleys, and in particular throughout the Yukon River Valley and its tributaries. At Fairbanks, *Betula alaskana* is growing in open woodland with *Picea glauca*.

OCCURRENCE.—Head of Goldstream, Buried Forest.

***Betula glandulosa* Michx.**

Figure 16

Several leaf specimens have been referred to *Betula glandulosa*, the scrub birch. This species has a wide geographic range. In California it is a dwarf shrub growing only in the higher mountains. It extends northward into Alaska where it is of common occurrence along the coast from Cape Nome to Kodiak Island and southward, spreading inland through the Yukon River drainage and Mt. McKinley National Park. *Betula glandulosa* usually grows in open forests with spruce; however, specimens have been collected from rocky hillsides near the north boundary of Mt. McKinley National Park, at an elevation of 2400 feet, as well as in the tundra along Norton Sound.

OCCURRENCE.—Head of Goldstream, Buried Forest.

***Arenaria sajanensis* Willd.**

Figures 55 and 56

Capsules and seeds of this circumpolar species are numerous.

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

***Silene acaulis* L.**

Figures 38 and 41

This is a common species in Arctic latitudes and in alpine Eurasia. Capsules and seeds are numerous in our collections.

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

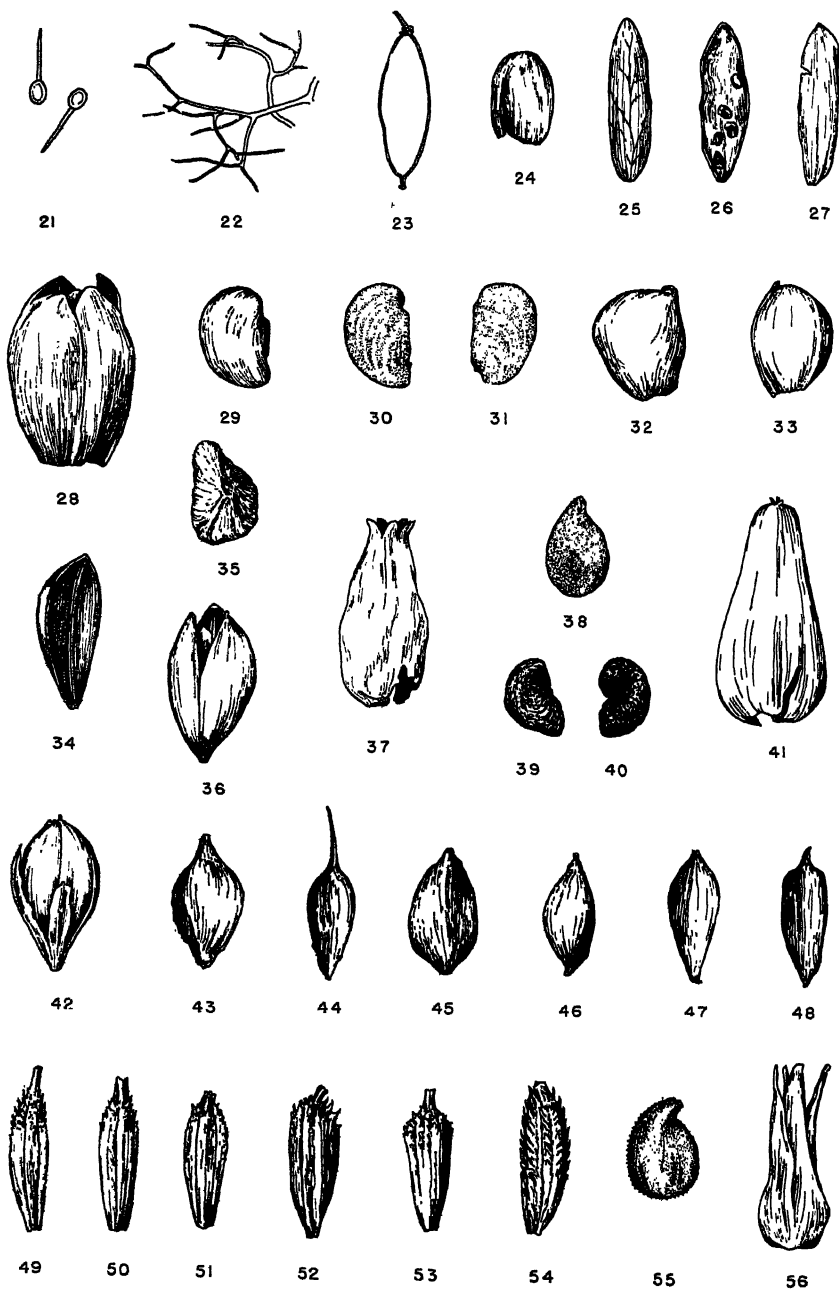
***Silene* sp.**

Figures 11 (in part), 37, 39 and 40

This is the most abundant fruiting structure in our collections. No modern species with corresponding capsules and seeds has been observed, but a further study of the members of this genus in high latitudes should result in the definite determination of our material.

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.





(See opposite page for captions)

## Captions for Figs. 21-56

Fig. 21. *Bovista plumbea* Pers. Spores.  $\times 200$ . From Plesiotype. A.C.-F:A.M.30845.

Fig. 22. *Bovista plumbea* Pers. Capillitia.  $\times 100$ . From Plesiotype. A.C.-F:A.M.30845.

Fig. 23. *Draba fladnizensis* Wulf. Replum.  $\times 5$ . Plesiotype. A.C.-F:A.M.30882.

Fig. 24. *Draba fladnizensis* Wulf. Seed.  $\times 18$ . Plesiotype. A.C.-F:A.M.30883.

Figs. 25-27. *Draba fladnizensis* Wulf. Capsule valves.  $\times 4$ . Plesiotype. A.C.-F:A.M.30884-6.

Fig. 28. *Androsace villosa* L. Capsule.  $\times 10$ . Plesiotype. A.C.-F:A.M.30890.

Fig. 29. *Potentilla villosa* Lehn. Seeds.  $\times 9$ . Plesiotype. A.C.-F:A.M.30887.

Figs. 30, 31. *Potentilla* sp. Seeds.  $\times 9$ . A.C.-F:A.M.30888, 30889.

Figs. 32, 33. *Ranunculus* cf. *eschscholtzii* Schlecht. Achenes.  $\times 10$ . Plesiotype. A.C.-F:A.M.30880, 30881.

Fig. 34. *Phlox* cf. *sibirica* L. Capsule valves.  $\times 6$ . Plesiotype. A.C.-F:A.M.30892.

Fig. 35. *Androsace villosa* L. Seed.  $\times 10$ . Plesiotype. A.C.-F:A.M.30891.

Fig. 36. *Phlox* cf. *sibirica* L. Capsule.  $\times 6$ . Plesiotype. A.C.-F:A.M.30893.

Fig. 37. *Silene* sp. Capsule.  $\times 3$ . A.C.-F:A.M.30877.

Fig. 38. *Silene acaulis* L. Seed.  $\times 12$ . Plesiotype. A.C.-F:A.M.30874.

Figs. 39, 40. *Silene* sp. Seeds.  $\times 15$ . A.C.-F:A.M.30878, 30879.

Fig. 41. *Silene acaulis* L. Capsule.  $\times 3$ . Plesiotype. A.C.-F:A.M.30875.

Fig. 42. *Phlox* cf. *sibirica* L. Capsule with calyx adhering.  $\times 6$ . Plesiotype. A.C.-F:A.M.30894.

Figs. 43, 44. *Carex* (?) sp. A. Achenes.  $\times 7$ . A.C.-F:A.M.30858, 30859.

Figs. 45, 46. *Carex* (?) sp. B. Achenes.  $\times 7$ . A.C.-F:A.M.30860, 30861.

Fig. 47. *Eriophorum* sp. A. Achene.  $\times 6$ . A.C.-F:A.M.30862.

Fig. 48. *Eriophorum* sp. B. Achene.  $\times 6$ . A.C.-F:A.M.30863.

Figs. 49, 50. *Taraxacum ceratophorum* (Led.) D.C. Var. A. Achenes.  $\times 5$ . Plesiotype. A.C.-F:A.M.30895, 30896.

Fig. 51. *Taraxacum ceratophorum* (Led.) D.C. Var. A (?). Achene.  $\times 6$ . Plesiotype. A.C.-F:A.M.30897.

Figs. 52, 53. *Taraxacum ceratophorum* (Led.) D.C. Var. B. Achenes.  $\times 5$ . Plesiotype. A.C.-F:A.M.30898, 30899.

Fig. 54. *Taraxacum ceratophorum* (Led.) D.C. Var. C. Achene.  $\times 5$ . Plesiotype. A.C.-F:A.M.30900.

Fig. 55. *Arenaria sajanensis* Willd. Seed.  $\times 12$ . Plesiotype. A.C.-F:A.M.30872.

Fig. 56. *Arenaria sajanensis* Willd. Capsule.  $\times 6$ . Plesiotype. A.C.-F:A.M.30873.

**Ranunculus cf. eschscholtzii Schlecht.**

Figures 32 and 33

Achenes of *Ranunculus* are less numerous than most other fruiting structures. They are not sufficiently well preserved to make certain their reference to the modern species *R. eschscholtzii*. In its modern distribution, this species ranges from Alaska to California where it is subalpine.

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

**Draba fladnizensis Wulf.**

Figures 23 to 27

The replums and seeds of this species are numerous. At the present time it is widely distributed in Arctic and alpine areas in the northern hemisphere.

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

**Potentilla villosa Lehn.**

Figure 29

Like most of the other herbs, this species is now circumpolar in distribution. Its seeds are numerous in our collection.

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

**Potentilla sp.**

Figures 30 and 31

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

**Androsace villosa L.**

Figures 28 and 35

The capsules and seeds of this species are relatively few in number. While it is found only at one locality, a more thorough search elsewhere

would probably disclose its presence. This species is now circumpolar in distribution.

OCCURRENCE.—Head of Goldstream.

*Phlox* cf. *sibirica* L.

Figures 34, 36 and 42

This circumpolar species is represented by numerous capsules, to some of which the calyx is attached.

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.

*Taraxacum ceratophorum* (Led.) D.C.

Figures 49 to 54

*Taraxacum* is represented by achenes, some of which retain portions of the beak. Considerable variation is evident in their surface features. Some of them are muricate only near the tip, while others are muricate considerably below the middle. These differences are used in modern plants to segregate species, but in the absence of any other portions of the plant it is considered best to treat them as an aggregate, under the name *T. ceratophorum*. There appear to be three different kinds of achenes, which are designated in the figure legends as Vars. A, B, and C.

*T. ceratophorum* is circumpolar in its modern distribution.

OCCURRENCE.—Head of Goldstream, 10 feet above gravel; head of Goldstream, 30 feet below surface; head of Goldstream, 25 feet below surface; head of Goldstream, 15 feet below surface; head of Gilmore, 20 feet below surface; two miles below Cleary, 25 feet below surface.



# AMERICAN MUSEUM NOVITATES

Number 888

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY, New York City

October 15, 1936

## NEW SPECIES OF POLYCHAETOUS ANNELIDS COLLECTED AT APPALACHICOLA, FLORIDA, BY DR. A. S. PEARSE, IN 1935

BY JANE K. WINTERNITZ<sup>1</sup>

### Syllidae

#### AUTOLYTUS GRUBE

##### *Autolytus brevicirrata*, new species

Body length about 2.5 mm.; width 0.5 mm. at anterior region, tapering to about 0.2 mm. at posterior end. Prostomium 0.5 mm. wide and 0.3 mm. long, rectangular in outline and lobed at the anterior margin. There are three pairs of eyes, the largest being situated between the most lateral and anterior pair, which are the smallest, and the fairly small more median pair. The prostomium probably bears three tentacles but only one is present in this specimen (figure 1). This tentacle is about six times as long as the prostomium. There are two pairs of lateral cirri, one pair quite short and the other nearly as long as the tentacle. The proventriculus bears no teeth and lies in somites six to ten. The dorsal cirrus of the parapodium is short compared to the tentacular cirrus, and it is about equal to one half the body width. The setae are all compound with a short beak-shaped terminal piece (figure 2). This specimen bears several sexual individuals in a chain. Each of these is about 1.2 mm. long and 0.4 mm. wide in the middle region, tapering slightly toward both ends. The body is full of eggs. The prostomium bears four short tentacles and two pairs of eyes, the large pair being most anterior.

LOCALITY.—Appalachicola, Florida. The type is in The American Museum of Natural History (Cat. No. 2271).

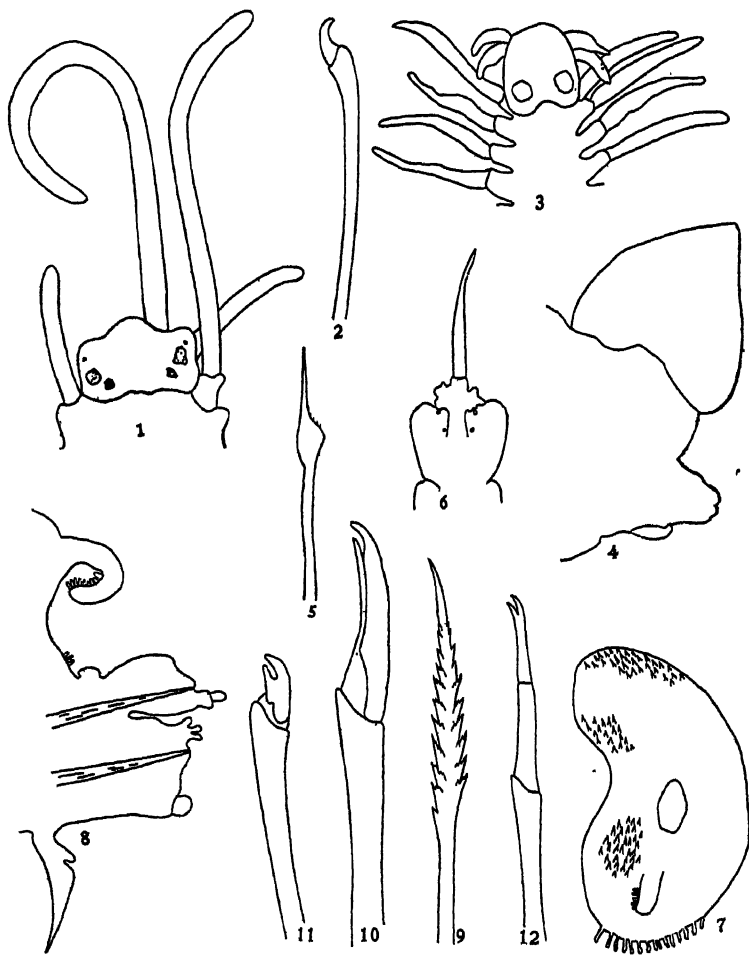
### Phyllodocidae

#### PHYLLODOCE SAVIGNY

##### *Phyllodoce uniccirrata*, new species

Body length 72 mm.; width 1 mm. at anterior end and 1.5 mm. in midregion, tapering to a point posteriorly. Prostomium length and width both less than 0.25 mm. Prostomium rounded and indented at the posterior margin (figure 3). It bears two pairs of tentacles which are about as long as the width of the prostomium, and one pair of large eyes at the posterior lateral margins. There are four pairs of lateral cirri which are not quite twice as long as the width of the prostomium. The parapodia and gills are of uniform structure throughout the body. The proportion of size of the gill to that of the somite is constant, the gills and somites both being smaller at the posterior end. The gills are in the form of low cones, their broad bases attached to the notopodium for their entire length. The notopodium is lobed at the outer margin and the ventral cirrus is much reduced (figure 4). The setae are all alike,

<sup>1</sup>Vassar College.



Figs. 1 and 2. *Autolytus brevicirrata*, new species. Fig. 1, prostomium,  $\times 30$ . Fig. 2, seta,  $\times 260$ .

Figs. 3 to 5. *Phyllodoce unicirrata*, new species. Fig. 3, prostomium,  $\times 30$ . Fig. 4, parapodium from anterior body region,  $\times 30$ . Fig. 5, seta,  $\times 120$ .

Figs. 6 to 12. *Eupholoe globosa*, new species. Fig. 6, prostomium,  $\times 12$ . Fig. 7, elytron from 15th somite,  $\times$  approx. 14. Fig. 8, parapodium from 15th somite,  $\times 25$ . Figs. 9 to 12, setae,  $\times 120$ .

each abruptly enlarged at the apex and continued into a long, narrow spine. Near the base of this spine are a few short, sharp spikes carried on the end of the broadened portion (figure 5). There is a pair of long anal cirri.

LOCALITY.—Appalachicola, Florida. The type is in The American Museum of Natural History (Cat. No. 2269).

### Polynoidae

#### EUPHOLOE McINTOSH

##### *Eupholoe globosa*, new species

Body length 50 mm.; width 3 mm. at anterior end, 2 mm. at posterior end. The tail region tapers gradually to a point. Prostomium (figure 6), length 0.5 mm., width 0.7 mm. Width greatest near the anterior end. There are two pairs of eyes, equal in size, one pair at the anterior prostomial edge and one pair at the base of the median tentacle. Median tentacle 1.2 mm. long, bearing two lateral flaps just above where it arises from the prostomium. Cirrophore of median tentacle about one-third the length of the prostomium; cirrus nearly twice the length of the prostomium. Palps twice as long as the median tentacle; colorless. The first parapodia extend forward close to the sides of the head and beyond the head a length equal to the length of the prostomium. The dorsal cirri of first parapodia are prominent and a little longer than the median tentacle. Dorsal surface of body completely covered with elytra which alternate irregularly with dorsal cirri. Elytra distinctly kidney-shaped anteriorly (figure 7) becoming slightly wider toward the posterior end. Each bears a ciliated cirrus situated just posterior to the region of attachment, besides about 15 other cirri and several patches of spines. On the parapodium (figure 8) the notopodium is rather blunt-edged, but bears a small lobe near the ventral surface. The neuropodium is also blunt but bears several small papilla-like lobes. The ventral cirrus is of medium length, acute, slender and points directly ventrally. Dorsal cirrus large and curled, and ciliated on the inner side. Dorsal-most notopodial setae long and slender and toothed on both margins. Others are shorter but have the same structure. Ventral-most on the notopodium are a few much shorter, stouter setae which are acutely pointed, and have a double row of toothed plates which become smaller toward the apex (figure 9). Setae of the neuropodia all heavy, compound and the same length as those on the ventral edge of the notopodium. The dorsal-most are heaviest, the basal joint expanding toward the apex (figure 10). The terminal joint has a slender apical and sub-apical tooth. Ventral to these some have shorter terminal joints (figure 11), beside some with long slender terminal joints and very fine apical and sub-apical teeth (figure 12).

LOCALITY.—Appalachicola, Florida. The type is in The American Museum of Natural History (Cat. No. 2270).





# AMERICAN MUSEUM NOVITATES

Number 889

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

October 19, 1936

## STUDIES OF PERUVIAN BIRDS. XXII<sup>1</sup>

### NOTES ON THE PIPRIDAE

BY JOHN T. ZIMMER

As in previous papers of the series, names of colors when capitalized indicate direct comparison with Ridgway's 'Color Standards and Color Nomenclature.'

I am greatly indebted to Dr. C. E. Hellmayr for notes on certain specimens in European museums which have been of great assistance in the present study.

#### *Pipra fasciicauda fasciicauda* Hellmayr

*Pipra fasciata* D'ORBIGNY AND LAFRESNAYE (nec THUNBERG, 1822), 1837, Mag. Zool., VII, cl. 2, Syn. Av., p. 38—Yuracares = Guarayos, Bolivia; ♂; Paris Mus.

*Pipra fasciicauda* HELLMAYR, 1906, Ibis, p. 9—new name for *Pipra fasciata* D'Orbigny and Lafresnaye.

Two males and a female from Candamo, southeastern Perú, belong to this Bolivian form. Hellmayr has compared skins from Yahuarmayo with the type and found them inseparable. Six males from Todos Santos and Mission San Antonio, nearer to Cochabamba than the type locality, are marked by a very slightly deeper shade of orange on the breast in some specimens, but the difference is inconsiderable. A single male from the "Falls of the Madeira" is definitely more reddish on the breast and comes very close to *scarlatina* which is found on the Gy-Paraná in western Brazil, not far to the eastward. Possibly this bird belongs to *scarlatina* rather than to *fasciicauda* though the locality is nearer to the range of the latter. Three skins, one female and two of uncertain sex, from the Province of Sara, between Cochabamba and Matto Grosso are indeterminate as to subspecies. They may be referred to *fasciicauda* until adult males are available for better determination.

The range of *fasciicauda* in Perú is restricted to the upper Tropical Zone in the southeastern part of the country. Records are from Yahuarmayo.

<sup>1</sup> Earlier papers in this series comprise American Museum Novitates Nos. 500, 509, 523, 524, 538, 545, 558, 584, 646, 647, 668, 703, 728, 753, 756, 757, 785, 819, 860, 861, and 862.

***Pipra fasciicauda purusiana* Snethlage**

*Pipra fasciicauda purusiana* SNETHLAGE, 1907, Orn. Monatsb., XV, p. 160—Ponto Alegre, Rio Purús, Brazil.

I have seen no topotypes of this form but I have several skins from eastern Perú which have been compared by Hellmayr with typical birds. Compared with these, other birds from the upper Ucayali show no more than individual differences. Hellmayr has noted that he found Purús examples (males) to have two or four median rectrices devoid of white, two or three external pairs banded with white, and the intervening feathers with a white patch near the base of the inner web; the Peruvian birds had the six median rectrices entirely black. The series now before me shows this character to be extremely variable in the Peruvian specimens. One bird has the four outer pairs of rectrices banded and the submedian pair marked with a white spot on the inner web. One skin has white only on the outermost pair where it crosses both webs, while five pairs are all black. Sixteen other males show the various stages of intermediacy between these two extremes. Apparently, therefore, there is no constant difference between the birds of the Purús and those of eastern Perú.

Specimens in the British Museum collected by Bartlett on the "Upper Ucayali" probably are from the neighborhood of Cashiboya and represent the lowest point on this river from which specimens have been obtained. All our material is from localities higher upstream.

A small series of skins from a hitherto unrecorded locality for the species, between the Huallaga and Marañón rivers, shows certain differences from *purusiana* which warrant the recognition of a new form to be known as follows.

***Pipra fasciicauda saturata*, new subspecies**

TYPE from Río Seco, west of Moyobamba, Perú; altitude 3000 feet. No. 234,908, American Museum of Natural History. Adult male collected July 22, 1925, by Harry Watkins; original No. 9485.

DIAGNOSIS.—Similar to *P. f. purusiana* but males with red of under parts deeper in color and of greater extent, invading the lower throat, the belly, and the under tail-coverts, at least on the tips of the feathers; flanks with subterminal portions of the feathers darker and more sooty; forehead lighter yellow, more sharply defined from the red of the crown.

RANGE.—Known only from the type locality in northern Perú, between the Marañón and Huallaga rivers.

DESCRIPTION OF TYPE.—Forehead Deep Chrome × Light Orange-Yellow in a band reaching back to the anterior border of the orbit, sharply defined from the red of the crown; remainder of the top of the head, neck, and a rounded "cape" on the anterior mantle rich blood-red, sharply defined from the deep, velvety black of the

remainder of the back and upper tail-coverts. Lores like forehead; upper and lower eyelids paler, Pinard Yellow, forming a narrow ring around the orbit; auriculars red, with yellow bases not entirely concealed; chin and anterior part of throat Light Cadmium but most of the throat with definite red tips; malar region anteriorly yellow, posteriorly tipped with reddish; breast, upper belly, and sides red like the crown; lower belly and basal half of under tail-covert region with red tips through which the Light Orange Yellow of the subterminal color is apparent; terminal half of the under tail-covert region black; flanks largely sooty blackish, with superior margins narrowly dull yellowish, inferior margins stained with reddish; some streaks of whitish on uppermost feathers; thighs yellow; tuft of silky feathers between femoral and spinal tracts yellowish white. Wings black, with a white patch on the inner webs of all the remiges medially; upper wing-coverts black; carpal margin and under wing-coverts yellow; axillars yellow stained with red. Tail black, with a yellowish white band crossing both webs of the outermost rectrices, crossing both webs (more narrowly) of the second pair, present on the inner web and a very narrow area of the outer web of the third, and occupying a small basal area on the inner webs of the fourth and fifth. Bill (in dried skin) black; feet dull maroon. Wing, 65 mm.; tail, 25; exposed culmen, 9.5; culmen from base, 13; tarsus, 15.

REMARKS.—Female much brighter yellow and olive than the same sex of *purusiana*. A slight tinge of red is present on the upper belly in the single female at hand. This may not be a constant character, since it is to be noted in occasional specimens of other forms.

This subspecies occupies a region which gives an extension to the known range of the species and is the farthest removed from any contact with the *aureola* group. Nevertheless, it presents characters that suggest some of the features of *aureola* and its allies, although there is still a taxonomic hiatus. The sooty flanks of *saturata* are not so fully black as in the *aureola* group; the basal region of the under tail-coverts is more broadly pale, though it is narrower in *saturata* than in other members of the *fasciicauda* group; the whitish markings on the tail form a band crossing both webs of at least two rectrices and are present on various other of the rectrices, whereas in the *aureola* group such markings are all but obsolete even on the outermost feathers; finally, the females of both groups are distinguishable by the color of the under tail-coverts, grayish olive in the *aureola* group and definitely yellowish in the *fasciicauda* group.

In the matter of range, there is no conflict between the two groups, but the distinction is as much altitudinal or ecological as geographical. The range of *aureola* as a species comprises the lower elevations in the Guianas and along the lower Amazon and the mouths of its tributaries only as far west as the Rio Negro and the left bank of the Rio Madeira. In the Amazonian portion of this range the habitat is largely, if not ex-

clusively, the "varzea" or periodically inundated area. At somewhat higher elevations occur the members of the *fasciicauda* group, reaching well down toward the mouths of the Tocantins and Tapajoz rivers (possibly also the Xingú), but withdrawing farther upstream along the Madeira where the fall is less rapid. It does not reach the main course of the Amazon at all nor the mouths of any of the tributaries, but extends across the headwaters of the Tocantins to the Paraná and westward across the Beni, Purús, and Ucayali into eastern Perú, reappearing in the form here described, between the Huallaga and the Marañón.

Some of the range of the *fasciicauda* group certainly is beyond and above the area of the "varzea," but part of it appears to overlap, and Dr. E. Snethlage has reported "*fasciicauda*" (= *scarlatina*) from the "varzea" of the lower Tocantins, although the locality, Arumatheua, is farther upstream than the places from which we have *aureola*—Mocajuba, Baião, and Ilha Taiuna. Thus it seems to be impossible to separate the ranges of the two groups on strictly ecological grounds although there is a factor of this nature which may have some fundamental bearing on the case.

So close are the two groups that it would require no great struggle to consider them as members of the same species. Nevertheless, each has developed a series of subspecies for itself forming two readily recognizable groups and it may be best to continue their recognition as two species.

Study of the *aureola* group in the present connection has brought out certain facts of distribution and taxonomy which may properly find a place in these pages as follows.

#### *Pipra aureola aureola* Linnaeus

*Pipra aureola* LINNAEUS, 1758, 'Syst. Nat.,' 10th Ed., I, p. 191—based on Edwards, 'Nat. Hist. Birds', II, p. 83, Pl. LXXXIII, fig. 2; "from some part of South America, near the equinoctial line" = Surinam, suggested by Hellmayr, 1906.

Four adult males from the Tocantins and six from the right bank of the Xingú are perfectly inseparable from thirty-two French, Dutch, and British Guiana birds, two from the mouth of the Orinoco, Venezuela, and two from Palheta, Brazil (Marajó Island?). The females of the various forms are not distinguishable in any case. The range of *aureola* must, therefore, be extended to include this eastern region south of the Amazon. West of the Xingú as far as the left bank of the Tapajoz, the birds are exactly intermediate between *aureola* and *flavicollis*. These intermediates have been described by Todd as *aurantiicollis*, under which name I have discussed them further.

**Pipra aureola flavicollis** Sclater

*Pipra flavicollis* SCLATER, 1851, Contrib. Orn., p. 153—Barra do Rio Negro (= Manaos), Brazil; ♂; British Mus.

There has been some uncertainty about the correctness of the locality where the type was collected and even yet this is the only specimen recorded from Manaos although Hellmayr (1929) accepted the citation at face value. Farther eastward, at Faro, the resident form is quite distinct from *aureola* and agrees with the characters ascribed to the Manaos form. Specimens from Obidos also have been assigned to *flavicollis* by Todd and by Hellmayr. One of the characteristics of *flavicollis* is the moderately broad and quite well-defined yellow frontal band, although a very few examples have a tinge of reddish on the forehead about as in *aureola*. In this respect, as also in the other peculiarities of *flavicollis*, five males from Villa Bella Imperatriz (east of the mouth of the Madeira) and ten from Rosarinho (west of the mouth of the Madeira) agree in detail and must belong to *flavicollis*. On the other hand, skins from farther up the Madeira, at Borba on the right bank and at Humaythá on the left bank, are immediately separable by a much wider yellow area on the forehead which is not at all sharply defined from the red crown but grades into it. So constant is this feature that I believe a new form may safely be described from this region, to be known as follows:

**Pipra aureola borbae**, new subspecies

TYPE from Borba, right bank of the Rio Madeira, Brazil. No. 279,908, American Museum of Natural History. Adult male collected February 5, 1930, by the Olalla brothers.

DIAGNOSIS.—Similar to *P. a. flavicollis* of Faro (and Manaos) but males with yellow of forehead much broader, reaching well behind the anterior border of the orbits and merged gradually into the red of the crown, not narrow and sharply defined. Tail averaging shorter. Distinguished from *P. a. aurantifrons* of the lower Tapajoz by paler yellow throat of a much broader extension over the chest and by a much broader yellow area on the forehead.

RANGE.—Right bank of the lower Rio Madeira (well above the mouth), Brazil, crossing to the left bank in the vicinity of Humaythá.

DESCRIPTION OF TYPE.—Forehead Cadmium Yellow, tinged with Orange at the tips, in a broad patch reaching to near the middle of the orbit where it merges into the color of the crown; crown, nape, and a broad circular "cape" on the anterior back brilliant red, with subterminal portions of the feathers deep yellow and bases white; rest of back deep black. Lores, a narrow line on upper eyelids, postocular area, base of auriculars, malar region, chin, and throat Cadmium Yellow; tips of auriculars and sides of neck red like the crown; breast and a rather broad stripe on the middle of the belly red; sides of breast yellow with red tips; flanks and sides of belly black; under tail-coverts black; thighs whitish, with a light yellow tinge; under wing-coverts white, with a yellowish tinge at the tips and with the carpal margin strongly Lemon

Chrome; a blackish patch at the bases of the under primary-coverts more or less prominent; axillars with deep Lemon Chrome tips and white bases; a tuft of silky white feathers on the sides of the body between the femoral and spinal tracts. Remiges black, with a large white patch on the inner webs of all the quills except the innermost tertial, though reduced in size on the outermost primary; upper wing-coverts black except for a yellow carpal margin and a yellow area on the smallest lesser coverts. Tail entirely black. Wing, 62 mm.; tail, 23; exposed culmen, 9; culmen from base, 12; tarsus, 15.

REMARKS.—Females indistinguishable from those of *flavicollis* and *aurantiicollis*.

The difference from *flavicollis* is perfectly diagnostic in fifteen adult males of the new form and twenty-three of *flavicollis*. One male of *borbae* and two of *flavicollis* have the forehead tinged with reddish, but the difference in the width of the area is still apparent in the two groups although in both cases there is no sharp dividing line between forehead and crown. In these two specimens of *flavicollis* the coloration of the forehead is like that of typical *aureola* although the throat is broadly yellow as in other *flavicollis*. One skin is from Faro and the other from Rosarinho (cf. account of *flavicollis*).

The passage across the upper Madeira to the left bank is interesting in view of the fact that *flavicollis* occupies the left bank at the mouth and *P. fasciicauda calamae* the right bank a little above Humaythá.

#### *Pipra aureola aurantiicollis* Todd

*Pipra aureola aurantiicollis* Todd, 1925 (July 15), Proc. Biol. Soc. Wash., XXXVIII, p. 96—Santarem, Brazil; ♂; Carnegie Mus.

The only specimens at hand from the type locality are two birds without given sex, apparently a female and a young male, neither of which show the diagnostic characters of this form. However, I have adult males from both east and west of this region which are more or less readily separable from both *aureola* and *flavicollis*, being intermediate between them, both in characters and distribution.

The forehead is very narrowly deep yellowish, not sharply defined from the red crown, comparing well with *aureola*. However, the throat is broadly yellow instead of reddish-tinged, being in pattern much as in *flavicollis* though the hue is slightly deeper. (A male from the Rio Jary has a slight tinge of red at the tips of the throat-feathers and appears to be an extreme of *aureola* since a Cayenne bird is very like it.) Since it is impossible to refer these males either to *aureola* or to *flavicollis*, the recognition of this intermediate form seems to be justified.

A female and a young male from Monte Alegre unfortunately are

not determinable as to subspecies. Since the locality is between Obidos and the Rio Jarý, it is possible that the form at Monte Alegre is the intermediate subspecies, *aurantiicollis*, but adult males will be needed to determine this point. In the meantime I tentatively refer these two specimens to *flavicollis*, the form recorded from Obidos.

## SPECIMENS EXAMINED

*P. f. fasciicauda*.—BOLIVIA: Todos Santos, 3 ♂, 1 ♀; Mission San Antonio, 4 ♂; Province of Sara, 1 ♀, 2 (?); Falls of the Madeira, 1 ♂. PERÚ: Candamo, 2 ♂, 1 ♀.

*P. f. purusiana*.—PERÚ: Río Ucayali, Lagarto, 11 ♂, 1 ♀; Santa Rosa, 6 ♂, 1 ♀; mouth of Río Urubamba, 1 ♂; Chuchurras, 4 ♂.

*P. f. saturata*.—PERÚ: Río Seco, west of Moyobamba, 4 ♂ (incl. type), 1 ♀.

*P. f. scarlatina*.—BRAZIL: São Paulo, Fazenda Cayoá, 3 ♂, 1 ♀; Iturerava, 1 ♂, 1 ♀; Minas Geraes, Rio Jordão, 3 ♂, 1 ♀; Goyaz, Fazenda Esperanza, 2 ♂; Matto Grosso, Chapada, 14 ♂, 9 ♀, 2 (?); Descalvados, 1 ♂; Tapirapoan, 1 ♀; Rio Tocantins, Arumatheua, 2 ♂; Rio Tapajoz, Itaituba, 1 ♂.

*P. f. calamae*.—BRAZIL: Rio Madeira, Calamá, 2 ♂ (incl. type), 2 ♀; Aliança, 1 ♂, 1 ♀; Rio Preto, Santa Isabel, 1 ♂, 1 ♀.

*P. a. aureola*.—DUTCH GUIANA: 14 ♂, 5 ♀, 1 (?). FRENCH GUIANA: 15 ♂, 9 ♀. BRITISH GUIANA: 15 ♂. VENEZUELA: El Pilar, 1 ♂; Las Barrancas, 1 ♀; Guanoco 1 ♂. BRAZIL: Palheta, near Pará, 2 ♂, 1 ♀; Rio Tocantins, Ilha Taiuna, 3 ♂, 1 ♀; Mocajuba, 2 ♂, 2 ♀; Baião, 1 ♀; Rio Xingú, Tapará, 7 ♂, 3 ♀; Rio Jarý, Santo Antonio de Cachoeira, 1 ♂.

*P. a. aurantiicollis*.—BRAZIL: Rio Tapajoz, Igarapé Amorin, 2 ♂, 1 ♀; Inajataba, 1 ♂; Santarem, 1 (♂), 1 (♀); Rio Amazonas, Tamucurý, 1 ♂.

*P. a. flavicollis*.—BRAZIL: Faro, 12 ♂, 9 ♀. Monte Alegre, 1 ♂, 1 ♀; Villa Bella Imperatriz, 7 ♂, 1 ♀; Rio Madeira (left bank), Rosarinho, 13 ♂, 12 ♀; Santo Antonio de Guajará, 1 ♀.

*P. a. borbae*.—BRAZIL: Rio Madeira (right bank), Borba, 8 ♂ (incl. type), 1 ♀; Igarapé Auará, 4 ♂, 1 ♀; (left bank), Humaythá, 6 ♂, 1 ♀, 1 (?).

*Pipra pipra pipra* (Linnaeus)

*Parus pipra* LINNAEUS, 1758, 'Syst. Nat.' 10th Ed., I, p. 190—based on "Cacototol" of Seba; "in Indiis" = Surinam.

*Pipra leucocilla* LINNAEUS, 1764, 'Mus. Ad. Frid.', II, Prodr., p. 33—no loc.; Surinam suggested by Berlepsch and Hartert, 1902.

I have examined a series of two hundred and thirteen specimens from the three Guianas; northern Brazil from Faro to Manacapurú, the Rio Branco, Rio Negro and Rio Uaupés, and from Teffé on the south bank of the Amazon; extreme eastern Colombia on the Uaupés; and Venezuela on the Cassiquiare, Orinoco, and Caura rivers and Mt. Duida. In all this material I am unable to find any constant characters of sufficient value to enable me to propose any subdivisions. In general, the crest of the males is long and extended well over the nape, with dusky bases on



all but some of the forehead feathers. The back is quite glossy, with a slight violaceous hue, and the belly and under tail-coverts are usually a little less glossy and less deeply black than the breast. Birds from Dutch and French Guiana and those from Faro, Brazil, average a little smaller than those from British Guiana, Venezuela, and the Rio Negro in Brazil, but there is no sharp line of demarcation and any division on these measurements would be rather arbitrary. The birds from Teffé appear to be typical, although *microlopha* occurs at São Paulo de Olivença, also south of the Amazon, farther west in Brazil.

*Pipra pipra comata* Berlepsch and Stolzmann

*Pipra comata* BERLEPSCH AND STOLZMANN, 1894, Ibis, p. 392—La Gloria, Chanchamayo, and Garita del Sol, Vitoc, Perú; cotypes in Frankfort Mus., Warsaw Mus. and Amer. Mus. Nat. Hist.

In an earlier paper (1929, Proc. Biol. Soc. Wash., XLII, pp. 85-88), I expanded the limits of variation of *comata* to include specimens from the Huallaga, but it now appears that these more northern specimens are distinct enough to deserve separate recognition. Typical *comata* apparently occupies a rather restricted range in the Chanchamayo and Urubamba valleys at relatively high elevations in the Tropical Zone, and males from this region are well-marked. The back is darker and slightly less glossy than in *pipra*, the crest is unusually long and full with white bases on all of the plumes, the wings and tail are long, but the bill is noticeably weak. A male from the mouth of the Urubamba River has shorter wings and tail but agrees in color characters and appears to be intermediate between *comata* and *microlopha*. No authentic females appear to have been described, but if a female from the mouth of the Urubamba belongs here instead of to *microlopha*, it may be distinguished from the females of *microlopha* by its much more whitish belly and throat and paler, less distinctly greenish breast. As in the male from the same locality, its measurements are small for *comata*, supposing the female of that form to approximate the male in size.

*Pipra pipra microlopha* Zimmer

*Pipra pipra microlopha* ZIMMER, 1929 (March 25), Proc. Biol. Soc. Wash., XLII, p. 85—Puerto Bermúdez, Río Pichis, Perú; ♂; Field Mus. Nat. Hist.

Additional material now before me confirms the characters of this form which is separable from *comata* by the markedly shorter crest of the adult males, with the bases of the forehead feathers white but those of the nape usually gray or dusky, while those of the crown are variably gray or whitish. The color of the back is about as in *comata*, with the

same degree of gloss, and the wing and tail are shorter though the bill is slightly wider at the base than in typical examples of *comata*. The females and young males are much like those of typical *pipra*.

The range of *microlopha* in Perú is in the lower Tropical Zone on affluents of the Pachitea and on the south bank of the Amazon below the mouth of the Ucayali. The situation on the Ucayali itself is not clear.

Our only specimen from Sarayacu, on the lower Ucayali, is a female which is not perfectly determinable as to subspecies although certain affinities are apparent. It agrees well with *Orosa* skins and is only slightly less whitish on the belly and a little darker green on the breast than the female of *comata*  $\times$  *microlopha* from the mouth of the Urubamba. It is too large to be associated with the form found at Chamicuro and Xeberos, although it is most like it in color. All characters considered, it is closest to *Orosa* specimens of the same sex, and it may be referred to *microlopha* without much question. An early record from Sarayacu, possibly the female recorded in the Catalogue of Birds of the British Museum as from "R. Ucayali," presumably represents the same form.

A disturbing factor is found in two adult males supposedly from Lagarto, on the right bank of the upper Ucayali, below the mouth of the Urubamba. These birds are neither *comata* nor *microlopha* but belong to the form found on the north bank of the lower Marañón and the lower Napo in eastern Ecuador. Several females and young males from Lagarto are uncertain as to race since I can find no distinguishing factors between these plumages of *microlopha* and the lower Napo form, to one or other of which they should belong. If the Lagarto birds are correctly labeled, the distribution of this form is peculiar as will be discussed under the proper heading. It would be expected that *microlopha* would occur at this locality.

#### *Pipra pipra occulta*, new subspecies

TYPE from Uchco, east of Chachapoyas, Perú; altitude 5000 feet. No. 234,914, American Museum of Natural History. Adult male collected November 3, 1925, by Harry Watkins; original No. 9842.

DIAGNOSIS.—Similar to *P. p. comata* of the Chanchamayo and Urubamba regions, but adult males with the occipital feathers slightly shorter and, with the crown and occipital feathers sooty at the base instead of entirely white. Wing and tail averaging shorter. Differs from *microlopha* of the Ucayali valley by definitely longer crest and somewhat more slender bill.

RANGE.—Higher elevations of the Tropical Zone in the Huallaga Valley from Chinchao to Uchco.

DESCRIPTION OF TYPE.—Whole top of head back to and including hind neck

white, with the bases of all the feathers behind the forehead sooty gray; forehead feathers white at base. White feathers on hind neck long (10 mm.) forming a sort of cape overlying the anterior part of the mantle. Remainder of upper surface deep steely black with a violaceous tinge and with a noticeable sheen. Lores, sides of head, and under parts like the back. Wings and tail sooty black, with a narrow border of violaceous-black on quills and upper wing-coverts. Under wing-coverts like breast. Wing, 66.25 mm.; tail, 31.5; exposed culmen, 7.5; culmen from base, 11; tarsus, 14.5; length of white cap from exposed base of culmen, 31.5; length of nuchal feathers, 10.

REMARKS.—Females are a little more yellowish green on the back than those of *microlopha*; the under parts are more strongly greenish, with darker and more grayish subterminal areas, especially noticeable on throat and belly. These green hues are all darker than in *coracina* which is otherwise suggested. Top of the head sometimes clear gray, including nape, sharply defined from the green of the back, but some skins have the cap overlaid with green as in other forms. Young males not certainly distinguishable from females (if my material is correctly sexed).

This is a form which I once (1929, Proc. Biol. Soc. Wash., XLII, p. 85) associated with *comata* but which I now believe to be distinct. The sooty bases of the crown and nape feathers are quite constant in all the adult males examined and their absence is equally constant in the Chanchamayo and Urubamba specimens of *comata*.

*Pipra pipra pygmaea*, new subspecies

TYPE from Chamicuros, Perú. No. 492,906, American Museum of Natural History (Rothschild Collection). Adult male collected May 6, 1867, by Edward Bartlett.

DIAGNOSIS.—Similar to *P. p. comata* of the Chanchamayo and Urubamba Valleys but size distinctly smaller; bases of occipital and nuchal feathers of adult males gray, not white, and crown-feathers also sometimes slightly ashy. Resembles *occulta* to a limited extent in this respect, but size smaller. Females and young males differ from those of *occulta* by much paler coloration; throat and belly decidedly more whitish; breast paler and duller greenish; back paler and duller green. The females and young males are much more like those of *microlopha* but are even lighter in coloration and, like the adult males, are smaller in size.

RANGE.—Tropical Zone of the lower Huallaga, on both sides of the river near its mouth.

DESCRIPTION OF TYPE.—Whole top of head white, back to a long nuchal crest; forehead and most of crown white at the bases of the feathers; occiput and nape very narrowly gray at bases; rest of upper surface glossy violaceous-tinged black; sides of head and under part of body very slightly less glossy than back and with a little tendency toward a more sooty tone on the belly and under tail-coverts. Wings and tail blackish with narrow glossy margins on quills and upper wing-coverts. Wing, 58 mm.; tail, 24; exposed culmen, 7; culmen from base, 11; tarsus, 11.25; crest from exposed base of culmen, 26.5; nuchal feathers, 10.5.

REMARKS.—Females are very similar to those of *microlopha* except for smaller size, but are slightly lighter in coloration, with the gray of the head overlaid with green and with the lower throat more whitish and the back averaging lighter green. Young males in first annual plumage are somewhat darker and more grayish green than the females and are grayer on the under parts, with the green of the breast in particular less pronounced than in the same plumage of *occulta*, approaching immature males of *microlopha* in this respect though not in size.

Several specimens of both sexes resemble the birds in first annual plumage except that the outer margins of the remiges are more yellowish and the upper wing-coverts somewhat brownish, being also softer in texture. This appears to be the juvenal plumage, at least in part, and it may be detected in the other subspecies by the same characters.

A female from Chamicuros is in unusual plumage, having the whole top of the head white with a slight admixture of gray, although the back matches normal adult females of *pygmaea* and the under parts are like young males of *pygmaea*. The specimen was collected by Bartlett who has labeled it as "♀ in male's plumage." Ridgway (1907, Bull. U. S. Nat. Mus., L (4), p. 745, footnote e) compared two supposed females from Chamicuros with a female "*bahiae*" (= *cephaleucos*) from Bahia and found much similarity. I have no females of true *cephaleucos* but the young males of that form are much darker on back and under parts than the aberrant female at hand from Chamicuros. This female may be one of the two seen by Ridgway; in any case the existence of another specimen like it from the same locality may indicate some factor in this plumage which still requires explanation. With normal examples of both adults and young of both sexes in hand, I am unable to find a place for this unusual plumage.

The measurements of the series of *pygmaea* and *occulta* show constant differences. Adult male *pygmaea*: wing, 58–61.5 mm.; tail, 24–25. Females: wing, 59–61.5; tail, 23.5–27. In *occulta* males: wing, 63–68; tail, 30.5–32. Females: wing, 64–65; tail, 33–34.

#### *Pipra pipra coracina* Selater

*Pipra coracina* SELATER, 1856 (June), P. Z. S. London, XXIV, p. 29—Bogotá; cotypes in British Mus.

The only properly assigned records of this subspecies from Perú are based on the specimens from Pomará in the present collection and a female from Chayavitas in the Tring collection, now also at hand. These birds agree in detail with birds from Bogotá and eastern Ecuador in the

higher portions of the Tropical Zone, as on the Río Suno and at Zamora.

The rich velvety black of the back of the adult males separates them from the males of any other Peruvian form and is equaled only by examples of *anthracina* (where the color of the back has even less violaceous tone and the feathers of the forehead, if not also the crown, have white bases) and *minima* (which is much smaller). The females and younger males, however, are separable from those of other forms by the very decided yellow coloration of the belly, often approaching Citron Yellow. A female from Andalucia, Colombia, and a probable young male from Antioquia are slightly darker and duller than Ecuadorian examples, but a female from Buena Vista, above Villavicencio, matches some of the Ecuadorian skins. The darker birds may show a very slight approach toward *anthracina*. The back also is between Oil Yellow and Yellowish Oil Green, a brighter hue than that of the other subspecies. The light gray of the head in the young males usually is sharply contrasted with the color of the back although sometimes there is a greenish tone on the occiput and nape which forms a transition between the two opposing hues. The females usually have the whole top of the head washed with green although one bird, sexed as a female, has a gray cap like some of the young males.

Young males in first annual plumage have the wings quite blackish except for the green outer margins of the outer web, and this green margin is obsolete at the bases of the quills, leaving a noticeable black patch just distad of the upper wing-coverts. The top of the head is very clear gray. These characters serve to distinguish this plumage from the adult females which do not have the black remiges nor so clear gray a cap, while the juvenals of both sexes have an even duller or greener cap and tend to show some brown on the upper wing-coverts.

#### *Pipra pipra* *discolor*, new subspecies

TYPE from Puerto Indiana, northern Perú. No. 232, 259, American Museum of Natural History. Adult male collected July 3, 1926, by Carlos Olalla and sons.

DIAGNOSIS.—Nearest to *Pipra pipra pipra* of the Guianas, southern Venezuela, and eastern Brazil north of the Amazon, but with the general color of the adult males somewhat glossier and distinctly bluer, less violaceous, with the black subterminal area of the feathers more sharply defined from the glossy tips. Much glossier than *coracina* of eastern Ecuador, nearer the Andes; bluer, less violaceous, and glossier than *microlopha* from northeastern Perú south of the Marañón, and with crest usually broader at the posterior end, occasionally tapered and rounded as in *microlopha*; wing longer than in *pygmaea* and feathers of crown grayer at their bases; general color much glossier than *comata* and crest shorter and with darker bases; less violaceous than *occulta* and with crest shorter.

RANGE.—Lower portions of the Río Napo in eastern Ecuador and Perú. Lower Tropical Zone.

DESCRIPTION OF TYPE.—Whole top and back of head white, with the feathers of the forehead whitish at their bases, those of the crown ashy gray, and those of the back of the head and the hind neck sooty; white feathers of anterior part of hind neck moderately long, forming a flattened crest somewhat rounded-truncate posteriorly and spread slightly over the anterior part of the mantle, concealing the feathers of the posterior part of the hind neck which are like the back. Back and upper tail-coverts near Dusky Slate; the glossy tips separated from the dull grayish bases by a band of deeper black which, in certain lights, is rather sharply defined from the glossy tips. Lores, sides of the head, and under parts about like the back, the belly slightly duller and blacker. Wings and tail sooty black, with a narrow border of glossy color like that of the back on the margins of the quills and upper wing-coverts; under wing-coverts like the breast. Wing, 67 mm.; tail, 24; exposed culmen, 8; culmen from base, 11; tarsus, 14; length of white cap from exposed base of culmen, 27; length of nuchal feathers, 10.

REMARKS.—The single female from north of the Amazon is not clearly separable from the same sex of typical *pipra*, although the wing is long (65 mm.) and the bill is smaller than usual in *pipra*.

Two adult males, one young male, and three females from Lagarto, right bank of the upper Ucayali, appear to belong here in spite of the curious distribution which this allocation predicates. The two adult males have all the characters of the lower Napo males and are distinguishable from *comata* of the Urubamba Valley as well as from *microlopha* which appears to intervene between Lagarto and the typical range of *discolor*. The specimens from Lagarto may possibly be incorrectly labeled and I prefer to see more material from the upper Ucayali before including Lagarto in the range of the Napo subspecies.

One male, labeled simply "Napo," from the Moore collection, agrees better with *microlopha* than with *discolor* and may also be incorrectly labeled and have come from the south bank of the Amazon, across from the mouth of the Napo.

#### *Pipra pipra cephaleucos* Thunberg

*Pipra cephaleucos* THUNBERG, 1822, Mém. Ac. Sci. St. Pétersb., VIII, p. 286—Brazil (I suggest Bahia); Upsala; ♂ in first annual plumage (Hellmayr).

*Pipra pipra bahiae* RIDGWAY, 1906, Proc. Biol. Soc. Wash., XIX, p. 117—Bahia; U. S. Nat. Mus.

Three adult males and three supposed males in first annual plumage from "Bahia," and one male in first annual plumage from "Rio (de) Janeiro" represent the typical form in the present collection. I have also forty-eight skins from more northern localities, ranging from the Pará region west to beyond the Rio Tapajoz. These northern birds

have been referred to *cephaleucos* (or *bahiae*) by authors, although the present series points to a western extension of the supposed range, heretofore thought to be only as far as the Tocantins.

However, the material in hand shows that there is a marked difference between the Bahia and Rio skins and the series from Amazonia when only the males in first annual plumage are compared with each other. Adult males are indistinguishable with certainty, although it is possible that the Bahia and Rio birds are very slightly duller and less glossy, especially on the belly. As to adult females, I am unable to speak without females of the Bahian form. Two of the four birds which I take to be young males are beginning a molt into adult plumage; the other two are like them except for this feature and I do not believe that any of them represents the female sex. All agree in the decidedly white cap which in two of the birds is as purely white as in the adult males; one has a faint trace of drab-gray on the shafts of the nuchal plumes; one has these grayish shaft-stripes a little broader and occurring also on the occipital region. The back is no brighter than Hellebore Green; the under parts are near Neutral Gray with the belly not appreciably paler but with a variable tinge of dull, dark green on throat, breast, sides, and flanks, although this may sometimes be absent.

The corresponding plumage of the Amazonian birds differs as is described below.

#### *Pipra pipra separabilis*, new subspecies

TYPE from Tapará, Rio Xingú, Brazil. No. 492,812, American Museum of Natural History. Male in first annual plumage, collected August 28, 1931, by Alfonso M. Olalla.

DIAGNOSIS.—Similar to *P. p. cephaleucos* of Bahia and Rio de Janeiro; adult males apparently indistinguishable, but males in first annual plumage separable by having the top of the head Pale Neutral Gray instead of white; back lighter green; under parts paler, especially on the belly, and with a stronger tinge of green on breast and flanks.

RANGE.—Region of the lower Amazon south of that river, from the left bank of the Rio Tapajoz eastward to the Tocantins and the district of Pará.

DESCRIPTION OF TYPE.—Whole top of head from forehead to the hind neck Pale Neutral Gray; back and upper tail-coverts very little darker than clear Yellowish Oil Green; lores dusky; auriculars and malar region Deep Neutral Gray; chin and throat Light Neutral Gray tinged with green (with several black feathers of the adult dress in place); center of the breast like the throat but sides decidedly greener, near Deep Grape Green; center of belly Pallid Neutral Gray; flanks broadly dark Grape Green; under tail-coverts slightly duller than the flanks. Remiges black, with a border of Jade Green along the outer margins of the feathers on the terminal two-thirds of the web, obsolete on the outer primaries, wider on the inner ones and on the

secondaries, and involving most of the outer webs and the tips of the inner webs of the tertials; primary-coverts like the primaries; rest of the upper wing-coverts with all exposed portions Jade Green; under wing-coverts Deep Neutral Gray with a faint wash of dark green. Tail blackish, with outer webs of all but the outermost feathers Jade Green, not quite reaching the tips, leaving a blackish terminal spot; inner webs of middle feathers less strongly greenish. Bill (in dried skin) blackish, with a small pale spot at tip of mandible; feet dull warm brown. Wing, 63 mm.; tail, 25; exposed culmen, 8; culmen from base, 11.75; tarsus, 13.

REMARKS.—Adult male moderately glossy violaceous black, with the belly rather duller and sometimes inclined to brownish; wings and tail with gloss confined to narrow margins; top of head, including moderately long occipital crest, white with narrow dusky or gray bases (except sometimes on anterior forehead which may be white to the base).

Adult female with back Yellowish Oil Green or even lighter; top of head Dark Olive Gray with a variable tinge of dull Lincoln Green; sides of head rather greener than crown; chin and throat greenish white or dull greenish yellow; breast and sides Vetiver Green; flanks brighter; belly like throat. Wings light fuscous with outer margins dull green; under wing-coverts Light Olive Gray. Remains of more juvenile plumage in some of the females shows the wings and wing-coverts duller and more buffy brown, with less depth of green.

Young males in juvenal plumage are like the young females in pattern but are darker and duller above and below. The cap is much like that of the adult female, without the clear gray of the first annual plumage, and the wings lack the pronounced black on the remiges that is characteristic of the first annual plumages of this form and *cephaleucos*. One skin with these juvenal wing-feathers, sexed as a male, has the cap clear gray, about Dark Gull Gray, without trace of greenish tinge.

Some of the males in first annual plumage from the Pará district have the forehead and part of the crown a little whitish, and one bird from the Xingú shows a lesser tendency in the same direction, but the skins from Bahia and Rio are quite decidedly whiter on the head, with the other coloration darker as indicated.

#### SPECIMENS EXAMINED

*P. p. pipra*.—DUTCH GUIANA: Lelydorp, 1 ♂; Libandoeg, 1 ♀; Rijsdijkweg, 1 ♂<sup>1</sup>; "interior," 6 ♂, 3 ♀. BRITISH GUIANA: Potaro Landing, 6 ♂, 3 ♀; "mines district," 2 ♂; Kamakusa, 5 ♂, 1 ♀; Rockstone, 3 ♂, 4 ♀; Tumatumari, 1 ♂, 3 ♀; Minnehaha Creek, 1 ♀; Wismar, 1 ♂; Demerara, 1 ♂, 1 ♂<sup>1</sup>; Hyde Park, 2 ♂<sup>1</sup>; Rio Carimang, 3 ♂<sup>1</sup>. FRENCH GUIANA: Ipousin, 2 ♂; St. Laurent du Maroni, 2 ♂<sup>1</sup>. BRAZIL: Faro, 16 ♂, 10 ♀, 2 (?); Manaus, 9 ♂, 4 ♀; Itacoatiara, 1 ♀<sup>1</sup>; Muirapinima, 1 ♂, 1 (?); Igarapé Cacao Pereira, 4 ♂, 3 ♀; Manacapurú, 3 ♂<sup>2</sup>; Santa

<sup>1</sup> Specimens in Field Mus. Nat. Hist., Chicago.

<sup>2</sup> Specimens in Carnegie Museum, Pittsburgh.



Maria, 2 ♂, 2 ♀; Tabocal, 1 ♂; San Gabriel, 1 ♀; Tatú, 2 ♀<sup>1</sup>; Mt. Curycuryari, 1 ♀; Rio Branco, Conceição, 2 ♂<sup>1</sup>, 1 ♀<sup>1</sup>; Rio Uaupés, Tahuapunto, 7 ♂, 4 ♀, 2 (?)<sup>1</sup>; Ianarete, 1 ♀; Teffé, 8 ♂. COLOMBIA: opposite Tahuapunto, Brazil, 2 ♂, 1 ♀; VENEZUELA: Río Cassiquiare, Solano, 1 ♂; Buena Vista, 1 ♂, 2 ♀, 1 (?)<sup>1</sup>; Río Orinoco, mouth of Río Ocamo, 3 ♂, 1 ♀; opposite mouth of Ocamo, 1 ♂; (western) foot of Mt. Duida, 1 ♂, 1 ♀; Río Caura, Suapüre, 9 ♂, 5 ♀; La Unión, 3 ♂; La Prición, 8 ♂, 3 ♀; Nicare 8 ♂, 1 ♀; Río Mato, 1 ♂; Mt. Duida (various camps), 8 ♂, 9 ♀.

*P. p. cephalucos*.—BRAZIL: "Bahia," 6 ♂; "Rio (de) Janeiro," 1 ♂.

*P. p. separabilis*.—BRAZIL: Para, 2 (?) (= 1 ♂, 1 ♀); Prata, 5 ♂, 2 ♀; Utinga, 3 ♂, 1 ♀; Providencia, 1 ♂, 1 ♀; Igarapé Assú, 1 (?)<sup>1</sup>; Santa Isabel (Para), 1 ♂; Peixe Boi, 1 ♂; Maguary, 1 ♂; Benevides, 1 ♂; Rio Tocantins, Mocajuba, 2 ♂, 2 ♀; Baião, 1 ♂, 1 ♀; Rio Majary, Recreio, 1 ♂, 1 ♀; Rio Xingú, Porto de Moz, 3 ♂, 1 (?)<sup>1</sup>; Villarinho do Monte, 2 ♂, 1 ♀; Tapará, 5 ♂ (incl. type), 1 ♀; Rio Tapajoz, Igarapé Brabo, 5 ♂, 1 ♀.

*P. p. discolor*.—PERÚ: Puerto Indiana, 2 ♂ (incl. type), 1 ♀; (? Lagarto<sup>3</sup>), 3 ♂, 3 ♀. Ecuador: mouth of Río Curaray, 8 ♂.

*P. p. comata*.—PERÚ: Garita del Sol, 1 ♂ (cotype); Idma, 2 ♂; mouth of Río Urubamba 1 ♂<sup>4</sup>, 1 ♀<sup>4</sup>.

*P. p. microlopha*.—PERÚ: Puerto Bermúdez, 5 ♂ (incl. type)<sup>1</sup>, 1 ♀<sup>1</sup>; Chuchurras, 2 ♂, 1 ♀; Orosa, 17 ♂, 4 ♀; Sarayacu, 1 ♀. BRAZIL: São Paulo de Olivença, 1 ♂<sup>2</sup>. ("Napo" errore), 1 ♂.)

*P. p. occulta*.—PERÚ: Uchco, 2 ♂ (incl. type), 2 ♀; Nuevo Loreto, 3 (?)<sup>1</sup>; Guayabamba, 4 ♂, 1 (?)<sup>1</sup>; "one of Baron's N. Peruvian skins, erroneously labeled Baeza, Ecuador," 1 ♂; Vista Alegre, 2 ♂<sup>1</sup>; Huachipa, 1 ♂<sup>1</sup>, 1 ♀<sup>1</sup>; Chinchao, 1 ♂<sup>1</sup>, 1 ♀<sup>1</sup>.

*P. p. pygmaea*.—PERÚ: Chamicuros, 5 ♂ (incl. type), 3 ♀; Jeberos, 1 ♂, 1 "♀" (= ♂ ?), 5 ♀; Yurimaguas, 1 ♂<sup>1</sup>.

*P. p. coracina*.—PERÚ: Pomará, 2 ♂; Chayavitas, 1 ♂. ECUADOR: Zamora, 2 ♂, 1 ♀; Guayaba, 1 ♂; Río Suno, above Avila, 1 ♂, 2 ♀; below San José, 9 ♂, 1 ♀; (no precise locality), 4 ♂. COLOMBIA: "Bogotá," 3 ♂, 1 ♂<sup>1</sup>; Buena Vista, 2 ♂, 1 ♀; Andalucía, 1 ♀; Antioquia, 1 (?)<sup>1</sup>.

*P. p. minima*.—COLOMBIA: Cocal, 3 ♂ (incl. type).

*P. p. anthracina*.—PANAMÁ: Chiriqui, 1 ♂; (Veraguas), 1 ♂<sup>1</sup>. COSTA RICA: Bonilla, 5 ♂.

### *Machaeropterus pyrocephalus pyrocephalus* (Sclater)

*Pipra pyrocephala* SCLATER, 1852, Rev. Mag. Zool., (2) IV, p. 9—locality unknown; subst. Upper Amazons, Ucayali, Berlepsch and Hartert, 1902; ♂; Paris Mus.

Peruvian specimens presumably are topotypical and agree with the figure of the type published in the 'Contributions to Ornithology' for 1852, Pl. xcvi, fig. 1. Skins from Matto Grosso are the same and an adult male from the Río Tapajoz is not clearly distinct. Two males from the Río Caura, Venezuela, differ from the skins from south of the

<sup>1</sup> Specimens in Field Mus. Nat. Hist., Chicago.

<sup>2</sup> Specimens in Carnegie Museum, Pittsburgh.

<sup>3</sup> Locality needs confirmation; see text.

<sup>4</sup> Not typical; see text.

Amazon sufficiently to warrant subspecific separation, and are described hereunder.

A young male from Fazenda Esperança, Goyaz, Brazil, extends the range of the species somewhat to the southeast.

Records in Perú are from Rioja, Moyobamba, the Ucayali, and the Marcapata Valley.

***Machaeropterus pyrocephalus pallidiceps*, new subspecies**

TYPE from La Prición, Río Caura, Venezuela. No. 493,143, American Museum of Natural History (Rothschild Collection). Adult male collected December 13, 1900, by E. André.

DIAGNOSIS.—Similar to *M. p. pyrocephalus* of northern Perú, south of the Amazon, but the yellow of head paler and the median stripe much less prominent, being nearly golden brown anteriorly and not very bright red posteriorly.

RANGE.—Known only from the type locality.

DESCRIPTION OF TYPE.—Top of head Lemon Chrome; a rather broad central stripe from the posterior border of the forehead to the nape, not very conspicuous; the anterior half of this stripe is hardly brighter than Yellow Ocher, with faint traces of brighter red which become more pronounced toward the occiput, giving the latter region a dull tinge or streaking of ill-defined scarlet; hind neck, back, and upper tail-coverts near Pecan Brown, with darker edges and paler centers; lateral interscapulars tipped with Roman Green. Auriculars Roman Green, with a slight touch of the same color in front of the eye; rest of lores Rood's Brown; narrow circumocular ring like the lores but with the tips of the feathers green; under parts with Vinaceous-Fawn centers and Sorghum Brown margins, giving a noticeably streaked appearance. Scapulars mostly Roman Green but posterior ones like the mantle; remiges mostly blackish with inner margins white (restricted to the middle of the inner margin on the outer primary, becoming more extensive toward the inner primaries and outer secondaries, and obsolete on the inner secondaries); outer margins of outer primaries largely or entirely black; of remaining primaries and outer secondaries, Roman Green; inner secondaries (with hypertrophied shafts) largely ashy gray, with green outer margins (distally), dusky tips, and a rounded blackish spot on the outer web before the tip and with suggestions of a dusky spot on the inner web of the innermost ones; tertials like the inner secondaries but with the tips greenish, and with the blackish spots becoming obsolete; primary-coverts and alula black; rest of upper wing-coverts Roman Green; under wing-coverts, axillars, and post-axillary tufts white, with a trace of vinous at the carpal margin of the wing. Tail stiffened, brownish, with a faint greenish tinge on the outer margins of the rectrices and an ashy tinge on the inner margins, especially of the outer feathers. Bill (in dried skin) with maxilla blackish, mandible warm brownish; feet light brown. Wing, 51.5 mm.; tail, 21.25; exposed culmen, 7; culmen from base, 10; tarsus, 14.

REMARKS.—Female unknown. A second male has the central head-stripe a little brighter than in the type, but it is still much less brilliant red than in typical *pyrocephala* and the rest of the top of the head is even paler yellow than in the type.

These specimens were once examined by Dr. Hellmayr who has commented on the reduction of red on the top of the head. The six adult males of *pyrocephala* now before me show so little approach toward the characters of the Venezuelan birds that, taking into account the wide separation of ranges, I believe that the subspecific distinction is fully warranted.

#### SPECIMENS EXAMINED

*M. p. pyrocephalus*.—PERÚ: Santa Rosa, Río Ucayali, 4 ♂, 2 ♀; Uchco, east of Chachapoyas, 1 ♂. BRAZIL: Utiarity, 2 ♂; Tapirapoan, 4 ♂, 2 ♀; Igarapé Brabo, Rio Tapajoz, 1 ♂; Tauary, 1 ♀; Piquituba, 1 ♂; Fazenda Esperança, Goyaz, 1 ♂.

*M. p. pallidiceps*.—VENEZUELA: La Prición, Río Caura, 2 ♂ (incl. type).

#### *Manacus manacus interior* Chapman

*Manacus manacus interior* CHAPMAN, 1914 (Nov. 21), Bull. Amer. Mus. Nat. Hist., XXXIII, p. 624—Villavicencio, eastern Colombia; ♂; Amer. Mus. Nat. Hist.

Two birds from Puerto Indiana, a female and a young male, agree with east-Ecuadorian and east-Colombian specimens in corresponding plumage, and evidently belong to *interior*. A young male from Orosa, south of the Amazon and east of the Ucayali, is not so certain. This bird is molting into the adult plumage and has the new feathers on the sides of the breast quite definitely gray, not white as they are in adult males of *interior*. The green of the breast and upper parts is somewhat lighter than in the average young male of *interior* and the lengths of wing and tail are short, agreeing with *subpurus* rather than with *interior*. The upper belly is pale yellow in distinct contrast to the green breast, and the under tail-coverts also are unusually pale, while the lower belly is white, apparently still in juvenal plumage. The throat, still in fluffy juvenal plumage, is distinctly whitish, and the chin and malar region are light olive gray.

These characters do not match those of any young males of surrounding forms of *manacus* and it is possible that an undescribed form is here awaiting description when adult males are at hand for study and definition. There is no other record from this particular portion of Perú. Specimens from Chayavitas, Pebas, Nauta, and Yurimaguas, and a sight record from Balsapuerto (Stolzmann) have been assigned to *interior*.

In examining the various subspecies for comparison, several points of interest have been uncovered. First to be noted is the fact that birds from Paramba, northern Ecuador, are not *leucochlamys*, as recorded, but *bangsi*. This is not surprising in view of the fact that the Río Mira, on

which Paramba is situated, has its mouth in close proximity to that of the Río Patia on which Barbacoas, the type locality of *bangsi*, is placed. A single male from San Javier, presumably near Paramba, is closer to *bangsi* than to *leucochlamys*. A male from Cachabi, on the other hand, appears to be true *leucochlamys*.

I am inclined to recognize *maximus* of the Alamor region as distinct from *leucochlamys*, although its distribution is very limited and its characters purely dimensional. Where the line should be drawn between them is problematical, as Dr. Chapman has already pointed out, but there certainly is a marked difference between the birds of Esmeraldas and Cachabi and those of Alamor, La Chonta, and Cebollal.

A small series of birds from the right bank of the Río Xingú, Brazil, are not intermediate between *purus* and *purissimus*, as would be expected from geographic reasons, but rather between *purissimus* and typical *manacus* of the north bank of the Amazon. Additional distinction from both of these forms leads me to describe the Xingú birds as new.

***Manacus manacus longibarbatus*, new subspecies**

TYPE from Tapará, Rio Xingú, Brazil. No. 429,836, American Museum of Natural History. Adult male collected August 23, 1931, by Alfonso M. Olalla.

DIAGNOSIS.—Combining certain characters of *manacus* and *purissimus* but with a longer "chin-beard" than either. White area on mantle broader and purer white than in *manacus* and the black portion of the back correspondingly narrower, the gray of the rump averaging somewhat broader. White area of the upper wing-coverts more extensive than in *manacus*, involving broadly the subterminal parts of the median series or even sometimes the greater series. Wing-tip shorter than in *purissimus* and with the outer primaries proportionately more slender; length of wing correspondingly shorter. Lower belly and thighs grayer, less whitish than in *purissimus*, though not so dark as in *manacus*, equaling *purus* in this respect.

RANGE.—Right bank of the Rio Xingú, Brazil, apparently extending eastward to the Tocantins.

DESCRIPTION OF TYPE.—Top of head glossy black, forming a rounded cap which involves the lores and superciliary region and reaches the nape. Hind neck and upper mantle white in a broad cape about 25 mm. in breadth; middle of back crossed by a black band about 20 mm. wide; rump and upper tail-coverts clear Slate-Gray. Under parts pure white except the lower flanks, lower belly, and thighs which are Deep Gull Gray, with narrow whitish tips on the thighs; under tail-coverts with a faint grayish tinge. Remiges black, with the inner margins of the secondaries whitish; greater upper wing-coverts and upper primary-coverts black; median upper coverts black only at tips, with the remainder of the feathers (back to the narrow gray bases) white; lesser series white; under wing-coverts and axillars white with a grayish tinge toward the carpal margin. Wing-tip short, 6 mm. between the tips of the longest primaries and secondaries. Tail black. Chin-feathers distinctly stiffened and long,

the longest 17 mm. Bill (in dried skin) dull blackish; feet pale buff, claws darker brown. Wing, 49 mm.; tail 30.5; exposed culmen, 9; culmen from base, 12; tarsus, 20.

REMARKS.—Females not clearly distinguishable from those of *manacus*, with which they agree in color as well as in the narrowness of the outer primaries and somewhat shortened wing-tip. Upper parts Light Hellebore Green, becoming duller on the breast and somewhat grayer on the throat; belly and under tail-coverts yellowish; wings and tail brownish black with exposed outer margins green like the back; under wing-coverts yellowish white except along carpal margin; inner margins of secondaries basally yellowish.

The long stiff beard of this form is shared with *M. m. abditivus* of the Santa Marta Region, but the other characters alternate between those of *manacus* and *purissimus*.

The distribution of this form on the Tocantins is puzzling. Three males and one female, labeled as from Baião (right bank of the Tocantins), unquestionably belong to the new form, but I have two males and one female, also apparently from Baião though obtained by other collectors and in other years, which are equally certainly *purissimus*. Other specimens of *purissimus* are at hand from Mocajuba, on the same side of the river as Baião though a little farther downstream. The two forms probably do not occur exactly side by side at Baião, but more field work will be necessary to determine the distributional limits, whether geographical or ecological.

#### SPECIMENS EXAMINED

*M. m. manacus*.—DUTCH GUIANA: 8 ♂, 1 ♀, 1 (?). FRENCH GUIANA: 21 ♂, 1 ♀. BRITISH GUIANA: 10 ♂, 2 ♀. BRAZIL: Faro, 14 ♂, 3 ♀, 1 (?); Monte Alegre, 1 ♂; Manaos, 22 ♂, 3 ♀; Igarapé Cacao Pereira, 2 ♂, 3 ♀, 1 (?). VENEZUELA: Río Cassiquiare (east bank), Buena Vista, 1 ♂.

*M. m. trinitatis*.—TRINIDAD: 14 ♂ (incl. type), 15 ♀, 2 (?).

*M. m. gutturosus*.—BRAZIL: Bahia, 9 ♂, 6 ♀, 1 (?); Rio de Janeiro, 1 ♂; Organ Mts., 1 ♀; Mt. Itatiaia, 1 (?); Estado São Paulo, 5 ♂, 5 ♀.

*M. m. purissimus*.—BRAZIL: Utinga, 2 ♂, 2 ♀; Prata, 4 ♂, 4 ♀; Maguary, 1 ♂; Marca de Legua, 1 ♂; Providencia, 1 ♂; Benefice, 1 ♀; Rio Tocantins, Baião, 2 ♂, 1 ♀; Mocajuba, 4 ♂, 3 ♀.

*M. m. longibarbatulus*.—BRAZIL: Rio Xingú, Porto de Moz, 5 ♂, 1 ♀; Tapará, 3 ♂ (incl. type); Rio Tocantins, "Baião," 3 ♂, 1 ♀.

*M. m. purus*.—BRAZIL: Rio Tapajoz, Piquiatuba, 2 ♂; Caxiricatuba, 1 ♂; Igarapé Brabo, 3 ♂; Igarapé Amorin, 2 ♂, 2 ♀; Tauary, 1 ♂, 1 ♀; Aramanay, 1 ♂, 4 ♀; Santarem, 6 ♂, 1 (?); Diamantina, 1 ♂; Rio Amazonas, Tamucurý, 1 ♀; Villa Bella Imperatriz, 9 ♂, 2 ♀.

*M. m. subpurus*.—BRAZIL: Tapirapoan, 1 ♂ (type); Mutum Cavallo, 1 ♂; Calamá, 2 ♂; Santa Isabel, Rio Preto, 1 ♂; Humaythá, 1 ♀; Jamarysinho, 1 ♂.

*M. m. interior*.—COLOMBIA: Villavicencio, 1 ♂ (type), 2 ♀; "Bogotá," 4 ♀, 2 (?). ECUADOR: Río Suro above Avila, 3 ♂, 1 ♀; lower Río Suro, 1 ♀; mouth of Río Curaray, 3 ♂, 5 ♀; Zamora, 1 ♂; (no locality), 1 ♂. PERÚ: Puerto Indiana, 1 ♂, 1 ♀. BRAZIL: Rio Negro, Yucabí, 1 ♂. VENEZUELA: Maripa, 6 ♂, 1 ♀; La Unión, 1 ♂.

*M. m. subspecies?*.—PERÚ: Orosa, 1 ♂.

*M. m. maximus*.—ECUADOR: Alamor, 6 ♂ (incl. type), 3 ♀; Cebollal, 1 ♂, 2 ♀; La Chonta, 2 ♀.

*M. m. maximus* × *leucochlamys*.—ECUADOR: Santa Rosa, 2 ♂, 4 ♀.

*M. m. leucochlamys*.—ECUADOR: Esmeraldas, 5 ♂ (incl. type), 1 ♀; Cachabi, 2 ♂; Río de Oro, 2 ♂; Bucay, 5 ♂; Coco, 2 ♂; Río Jubones, 1 ♂; Chimbo, 1 ♂, 3 ♀; Naranjo, 1 ♂, 1 (?); coast of Manaví, 1 ♂, 1 ♀; Quevedo, 1 ♂; Duran, 1 ♂.

*M. m. bangsi*.—COLOMBIA: Barbacoas, 7 ♂ (incl. type), 3 ♀. ECUADOR: Paramba, 5 ♂, 1 ♀; San Javier, 1 ♂.

*M. m. flaveolus*.—COLOMBIA: "Bogotá," 10 ♂; Espinal, 1 ♂; Chicoral, 4 ♂, 1 ♀; Honda, 1 ♂; near Honda, 6 ♂.

*M. m. additivus*.—COLOMBIA: Cacagualito, Santa Marta, 5 ♂, 1 ♀; Minca, 3 ♂, 1 ♀; Don Diego, 1 ♂, 1 ♀; Bonda, 2 ♂, 3 ♀; Massinga la Vieja, 1 ♂; Donama, 1 ♂; Jordan, 1 ♀; Antioquia, 2 ♂; Malena, 1 ♂; Puerto Valdivia, 1 ♂.

### *Schiffornis turdinus amazonus* (Sclater)

*Heteropelma amazonum* SCLATER, 1860, P. Z. S. London, XXVIII, p. 466—Chamicuro, Perú; British Mus.

I have no strictly topotypical material of this subspecies, but an example from the upper Ucayali agrees so well with upper Rio Negro (Brazil) and southwest-Venezuelan examples (birds from this area have been assigned to *amazonus* by various authors) and shows such relationship to *wallacii* of the lower Amazon, that there is little doubt as to the correct assignment to this form. The dull-colored belly, the moderately developed tawny coloration of the throat, the distinctly brown cap, and the dark and moderately brownish back are characters which appear in specimens from these various regions. Skins from the lower Amazon which belong to *wallacii* are paler throughout than *amazonus* but have the same style of coloration. In general, the top of the head is only slightly brownish and the throat but little tinged with pale fulvous, and examples from the Tocantins and the Pará district that I have seen are all of this complexion; but specimens from the Tapajoz and westward rather frequently show an increasing warmth of color on the head and throat, reaching a development on the Rio Madeira that strongly suggests *amazonus* although the belly remains pallid and the back lighter olivaceous than in the more western form. At the same time, certain specimens from this whole region remain inseparable from the birds from Pará. Consequently I believe that *wallacii* extends westward at least

as far as the Madeira with increasing tendencies toward certain characters of *amazonus* as the range of the latter is approached.

One skin from the Lawrence collection, without original label but said to be from the "Upper Amazon," is of doubtful identity. It does not exactly match any other specimen of any subspecies now before me. The throat is rather warmly colored and the belly is pale as in *wallacii* though of a faintly more brownish tint. The top of the head is strongly rufescent brown of a brighter hue than in most *amazonus*. The back is brown, paler than in other skins that belong to *amazonus* but browner than in *wallacii*. The nearest approach to the coloration of this skin is found in a female from Nericagua, Río Orinoco, but the resemblance is far from exact.

A single female from the mouth of Lagarto Cocha, southeastern Ecuador, is very similar to the Ucayali bird and to the southwest-Venezuelan specimens, although it is a trifle more greenish on the belly, probably in an approach toward the birds of Ecuador from higher elevations. Lagarto Cocha is on the Amazonian plain and logically comes within the range of *amazonus* as it reaches from eastern Perú across the lowlands to the upper Río Negro and the upper Orinoco.

Peruvian records are from Chamicuros, Yurimaguas, "Río Ucayali," and Soriano.

As indicated in a preceding paragraph, specimens from eastern Ecuador and adjacent parts of northern Perú, taken at relatively high elevations in the Tropical Zone, are different from *amazonus*, and as they are also recognizably distinct from *rosenbergi* of the western slopes of the Ecuadorian Andes, they deserve a separate name as follows.

***Schiffornis turdinus aeneus*, new subspecies**

TYPE from Chaupe, Perú; altitude 6100 feet. No. 181,504, American Museum of Natural History. Adult male collected April 12, 1923, by Harry Watkins; original No. 7248.

DIAGNOSIS.—Nearest to *S. t. rosenbergi* of western Ecuador and southwestern Colombia, but upper parts browner, less greenish; crown with more decided rufescence; breast more strongly brownish but belly rather brighter greenish; outer surface of wings warmer brown.

Compared with *S. t. amazonus* of eastern Perú, the whole coloration is much brighter, with a stronger greenish tinge throughout and with the belly, in particular, decidedly greener, the breast a more golden brown, and the back more bronzy.

RANGE.—The eastern slope of the eastern Andes in Ecuador and the adjacent portion of Perú north of the Marañón, not extending very far into the Amazonian plain.

DESCRIPTION OF TYPE.—Upper parts somewhat browner than Medal Bronze; forehead with a grayish tinge; crown and occiput strongly suffused with light Argus

Brown; sides of head somewhat dusky in tone. Chin and throat Orange-Citrine; breast Saccardo's Olive; belly near Yellowish Olive. Wings and tail Clove Brown with exposed outer margins of the remiges Prout's Brown; outer margins of the rectrices more like the back; greater and median upper wing-coverts like the remiges; lesser coverts like the back. Under wing-coverts grayish, with paler tips and with a pale greenish tinge at the carpal margin. Bill (in dried skin), dull blackish; feet reddish brown. Wing, 93.5 mm.; tail, 71; exposed culmen, 13; culmen from base, 17; tarsus, 22.

REMARKS.—Females like the males in color but somewhat smaller (wing, 86–88.5 mm.; tail, 61–63 as against 91–94 and 66–72.5, respectively).

This form has been misidentified heretofore as *amazonus*, but it is a quite different bird and resembles *rosenbergi* more than it does *amazonus*. It stands exactly between *rosenbergi* and *furrus* in appearance. In dorsal aspect, *aeneus* and *furrus* are exceedingly alike, but *furrus* usually is more deeply golden on the throat and breast and its extremes are also browner on the back.

The range of *furrus* probably is more extensive than has been supposed. Two males from Chocó, Colombia (probably near Quibdó), a female from Primavera, and a male from the Nóvita trail all have a browner back, more rufescent crown-patch, and more pronouncedly golden-bronzy throat than any of the specimens from western Ecuador or extreme southwestern Colombia. They agree much better with *furrus* than with *rosenbergi*, and I suspect that *furrus* finds its way from the Tacarcuna region of eastern Panamá, up the Atrato Valley and into the upper confines of the Río San Juan Valley. In the other direction, *furrus* extends through Panamá into the mountains of Veraguas which it occupies on both Caribbean and Pacific slopes without descending into the coastal western forests on the Pacific side where *verae-pacis* is in possession, nor the eastern ones where *panamensis* is found.

#### *Schiffornis turdinus steinbachi* Todd

*Schiffornis turdinus steinbachi* Todd, 1928 (June 29), Proc. Biol. Soc. Wash., XLI, p. 113—Yapacani, Prov. del Sara, Bolivia; ♂; Carnegie Mus.

I have no Peruvian material from the southeastern part of the country and follow Hellmayr in referring the records from that region to the Bolivian form. I would amend Hellmayr's assignment of the Cosñipata record to *amazonus* by placing it under *steinbachi*, since Cosñipata is in the Madre de Dios drainage along with Río Cadena and Chontapuncu (Marcapata Valley) though on an adjacent tributary. Records thus comprise Río Cadena, Chontapuncu, and Cosñipata.



## SPECIMENS EXAMINED

*S. t. verae-pacis*.—GUATEMALA: 3 (?). NICARAGUA: Río Grande, 1 ♂, 1 ♀; Savala, 2 ♂; Los Sabalos, 1 ♂; "state of Matagalpa or borders," 1 (?). COSTA RICA: Carrillo, 1 ♂; Miravalles, 1 ♂, 1 ♀; La Iberia, 2 ♂; El Pozo, Río Terraba, 1 ♂; Guacimo, 1 ♂; Palmar, 1 ♂; Jimenez, 1 ♂; Puerto Jimenez, 2 ♂; Bonilla, 1 ♀; Volcán de Oso, 1 ♀.

*S. t. panamensis*.—PANAMÁ: El Real, 2 ♂, 5 ♀ (incl. type.); Tapalisa, 1 ♀; Chepigana, 1 ♀; (Lion Hill), 1 ♂, 1 ♀; Río Sambú, 1 ♂; Cape Garachiné, 1 ♂; savanna near Panamá, 1 ♀.

*S. t. furvus*.—PANAMÁ: Guaval, Río Calovévora, 3 ♂, 4 ♀; Santa Fé, Veraguas, 3 ♂, 1 ♀; Tacarcuna, 2 ♂, 1 (?); east slope of Mt. Tacarcuna, 7 ♂; Cascajal-Coclé, 1 ♂; El Villano, 1 ♂; La Marea, 1 ♂. COLOMBIA: Chocó, 2 ♂; Primavera, 1 ♀; Névita trail, 1 ♂.

*S. t. rosenbergi*.—COLOMBIA: Barbacoas, 1 ♀; Buena Vista, 1 ♀. ECUADOR: Esmeraldas, 1 ♂, 1 ♀; Cachavi, 1 ♂; Chimbo, 1 ♂; Mindo, 1 ♀; Cachiyaçu, 1 ♂, 1 ♀; Lita, 1 ♂, 1 ♀; La Puente, 1 ♀; Alamor, 1 ♂.

*S. t. aeneus*.—ECUADOR: Zamora, 4 ♂; Sabanilla, 1 ♀; San José de Sumaco, 1 ♂, 2 ♀; lower Sumaco, 1 ♂, 1 ♀; Macas region, 1 (?). PERÚ: Chaupe, 3 ♂ (incl. type).

*S. t. steinbachi*.—BOLIVIA: Mission San Antonio, 2 ♂, 3 ♀.

*S. t. amazonus*.—PERÚ: Lagarto, 1 ♂, Huachipa, 1 ♀<sup>1</sup>. ECUADOR: mouth of Lagarto Cocha, 1 ♀. "Upper Amazon": 1 (?). VENEZUELA: Boca de Sina, 1 ♂; (western) foot of Mt. Duida, 1 ♂; (southern) foot of Mt. Duida, 1 ♂; Solano, 1 ♂; Río Huaynia, 4 ♂, 2 ♀, 1 (?); mouth of Río Ocamo, 1 ♀; Nericagua, 1 ♀; Munduapo, 1 ♂, 1 ♀.

*S. t. wallacii*.—BRAZIL: Rio Madeira, Humaythá, 2 ♂, 2 ♀; Calamá, 1 ♂; Aliança, 1 ♂; Borba, 1 ♀; Igarapé Auará, 1 ♂; Rio Machados, Maruins, 1 ♀; Rio Roosevelt, "Camp 22," 1 ♀; Morinha Lyra, 1 ♀; Villa Bella Imperatriz, 2 ♂, 1 ♀; Rio Tapajoz, Igarapé Brabo, 1 ♂, 2 ♀; Caxiricatuba, 1 ♂, 2 (?); Limoal, 1 ♂, 2 ♀; Tauarý, 2 ♂; Rio Tocantins, Baião, 1 ♂, 1 (?); Rio Xingú, Victoria, 1 (?); Porto de Moz, 1 ♀; Utinga, 1 ♂; Prata, 4 ♂; Faro, 2 ♂, 2 ♀, 1 (?); Obidos, 1 ♂, 1 ♀. DUTCH GUIANA: near Paramaribo, 2 ♂; "interior," 2 ♂.

*S. t. olivaceus*.—BRITISH GUIANA: Camacusa, 2 ♂, 2 ♀, 1 (?); Bartica Grove, 1 ♂; Carimang River, 1 ♂; Potaro Landing, 1 ♂; Tumatumari, 1 ♂. VENEZUELA: Río Mato, 1 ♀ (type); La Prición, 1 ♀; Nicare, 1 ♀.

*S. t. stenorhynchus*.—COLOMBIA: Santa Marta, Cacagualito, 1 ♀, 1 (?); Bonda, 1 ♀, 2 (?); Onaca, 1 (?); El Consuelo, above Honda, 1 ♂.

*S. t. turdinus*.—BRAZIL: "Bahia," 1 (?); "Rio Janeiro," 1 (?); "Brasilia," 1 ♂.

## Schiffornis major major Des Murs

*Schiffornis major* DES MURS in CASTELNAU, 1856 (June), 'Expéd. Amér. Sud,' Ois., livr. 18, p. 66, Pl. XVIII, fig. 2 (*Schiffornis* on plate)—Sarayaçu, Perú; Paris Mus.

*Heteropelma rufum* PELZELN, 1868 (Sept.), 'Orn. Bras.,' II, p. 185—Borba and Rio Amajáu, Brazil; Vienna Mus.

A series of twenty-two specimens from northeastern Perú and the

<sup>1</sup> Specimen in Field Museum of Natural History, Chicago.

Rio Madeira, Brazil, shows all intermediate types of coloration between the gray-headed extreme and the purely rufous opposite. Six birds have only the slightest, or no, trace of gray in the plumage. Five of these are from Perú; one is from Rosarinho, Brazil. Nine skins have a varying amount of gray around the eyes but none on the top of the head. Three of the birds with the least amount are from Perú, and one is from Brazil. The remaining seven specimens (all from Brazil) agree among themselves in having some gray on the top of the head, but they differ from each other in various particulars. One Peruvian female has gray around the eye and a few grayish feathers on the forehead, while the mantle-feathers are faintly clouded in their centers. A male from Perú has the whole top of the head rather uniformly olivaceous gray with bright ochreous marginal spots on the feathers giving an orange-colored tinge to the whole area, particularly strongly on the forehead. The sides of the head are somewhat similar. Another Peruvian male has the forehead rather clear gray, with dusky shafts, and with a faint ochraceous-orange tinge. The occiput is deep Sanford's Brown with very narrow grayish tips, and the crown shows the transition between these two extremes. The hind neck is somewhat more broadly tipped with gray than the occiput. Two males from the lower Rio Madeira are much like the last-described Peruvian bird. A female from the same region has the whole top and the sides of the head dull gray with the forehead suffused with orange-ochraceous and with a strong tinge of the same color nearly concealed on the subterminal portions of the feathers of crown and occiput. A female from the Rio Machados is mostly rufescent, but the mantle is a little duller than Cinnamon-Rufous and the tips of the rufous feathers on the top of the head are Drab.

None of these birds has any definite gray on the throat although Taczanowski has described the type of *major* as having the throat gray washed with rufous. Hellmayr (1910, 'Gen. Avium,' pt. 9, p. 23) has discussed various other specimens from Perú and Brazil, and, judging from his descriptions, the range of variation in his material was about as I have noted for the series now in my hands.

This evidence substantiates Hellmayr's conclusions that "*Heteropelma rufum*" is a synonym of *Schiffornis major*. The two styles of plumage are no more than extremes of individual variation, occurring without regard to age, sex, season, or locality. Within the rufous extremes there is considerable variation in regard to depth of color. Some specimens have the whole under parts almost uniformly colored; others have the belly much paler than the breast. Similarly on the upper parts, there is

sometimes little change of tint on the rump though this area is usually much paler than the mantle which also is variable in depth of hue and sometimes has a slight brownish tinge.

Six specimens from the neighborhood of Mt. Duida, Venezuela, not included in the above analysis of characters, show a new extreme not only in the known distribution of the species but in the development of a gray head and a brown mantle, and are so different from any of the other specimens at hand that I believe them to represent a distinct subspecies. Accordingly, I describe them as hereunder.

Records of *major* include Nauta and Samiria, Peruvian localities not represented in the material at hand.

A careful study of this species in comparison with *Schiffornis turdinus* in its various forms leads me to place the two species in the same genus. The only character of any permanence is that of color; whereas *major* is strongly rufescent, *turdinus* is olive and brown. The bill of *major* averages shorter than that of *turdinus*, as do also the tail and tarsus, but there are specimens in both species which can be matched in these respects which, after all, are hardly of generic value. The scutellation of the tarsus and the degree of syndactylism of the toes are comparable in both species and show their close affinity in family relationship.

#### *Schiffornis major duidae*, new subspecies

TYPE from the right bank of the Río Cassiquiare, Venezuela, opposite El Mery. No. 433,387, American Museum of Natural History. Adult female collected April 15, 1929, by the Olalla brothers.

DIAGNOSIS.—Similar to the gray-headed phase of *S. m. major*, but the gray of the head clearer and more extensive, without definite rufescence on the concealed portions of the feathers from the forehead to the hind neck; upper back decidedly brown instead of rufous.

RANGE.—At present known only from the vicinity of Mt. Duida, Venezuela.

DESCRIPTION OF TYPE.—Whole top of head and hind neck slightly clearer than Deep Mouse Gray; mantle dark Saccardo's Umber; upper margin of rump Cinnamon-Rufous × Orange-Rufous, passing into Apricot Buff × Ochraceous-Buff on the lower rump and upper tail-coverts. Sides of head a little paler gray than the crown; chin whitish; throat Light Grayish Olive, with slight traces of cinnamonaceous buff on the margins of the central feathers; breast crossed by a band of Orange-Rufous × Cinnamon-Rufous, becoming duller and browner on the sides; belly and under tail-coverts deep Ochraceous-Buff, deeper on the flanks. Wings dusky; outer margins of primaries near dark Olive Brown; those of secondaries becoming brighter and approaching Ferruginous × Hazel on the tertials; upper wing-coverts dull brownish, the greater and median series tipped with the color of the tertials (not sharply defined); lesser series near the color of the back; inner margins of remiges Light Pinkish Cinnamon, withdrawn basad on the outer primaries; under wing-coverts and axillars light Cinnamon-Rufous. Tail dark Cinnamon-Rufous. Bill (in dried skin),

blackish; feet blackish brown. Wing, 80 mm.; tail, 56; exposed culmen, 11; culmen from base, 16; tarsus, 20.25.

REMARKS.—Males like the females.

Although this form might appear to represent only the extreme development of typical *major*, it has gone so far as to stand well by itself and deserves separate recognition. None of the twenty-two examples of true *major* approach the *Duida* birds very closely either in respect to the unmixed gray of the top of the head or the strong brownish hue of the mantle. There is also a probability that the grayish throat of *duidae* is an additional character, being quite definitive in the material at hand, but Taczanowski (1884, 'Orn. Pérou,' II, p. 352) describes the type of *major* as having the throat gray, washed with rufous, apparently as it is in the series of *duidae*.

#### SPECIMENS EXAMINED

*S. m. major*.—PERÚ: Sarayacu, 2 ♂, 3 ♀; Lagarto, Río Ucayali, 2 ♂; Puerto Indiana, 1 ♂, 1 ♀; Anayacu, 1 ♀. BRAZIL: Rosarinho, 1 ♂; Borba, 4 ♂, 1 ♀; Igarapé Auará, 1 ♂, 1 ♀; Calamá, 1 ♂, 1 ♀; Jamarysinho, 1 ♀.

*S. m. duidae*.—VENEZUELA: Río Cassiquiare, opposite El Merey, 1 ♂, 1 ♀ (type); Caño León, Mt. Duida, 2 ♂, 1 ♀; Boca de Sina, Río Cunucunumá, 1 ♀.

#### *Heterocercus aurantiivertex* Sclater and Salvin

*Heterocercus aurantiivertex* SCLATER AND SALVIN, 1880, P. Z. S. London, p. 157—Sarayacu, Ecuador; cotypes in British Mus.

I have no specimens of this exceedingly rare form. Two specimens in the British Museum from Chamicuros were referred by Sclater ('Cat. Birds Brit. Mus.,' XIV, p. 325) to *flavivertex*, but the reference was transferred by Hellmayr to *aurantiivertex* with a note to the effect that one young male from Chamicuros had the bright crown feathers, that were just appearing, of a golden-yellow color.

There are no other Peruvian records. Peruvian material of this genus at hand belongs to *linteatus*, as is discussed below.

#### *Heterocercus linteatus* (Strickland)

*Elaenia linteata* STRICKLAND, 1850, Contrib. Orn., p. 121-15 (part; descr. "male"), Pl. (LXIII), (part; left fig.)—"Upper branches of the Amazon River"; ♂; Acad. Nat. Sci. Phila.

Puerto Indiana, 1 ♀; ["Upper Amazon,"], 1 ♂.

These two specimens must be referred to *linteatus* and not to *flavivertex* or *aurantiivertex* as the locality north of the Amazon (Puerto Indiana) might indicate as probable.

The Puerto Indiana female has the under parts paler and more

ochraceous in tone, less cinnamomeous, than females of either *linteatus* or *flavivertex* from other localities. The upper parts also are slightly paler than in most female *linteatus*, but are still a brownish olive far removed from the bright Warbler Green or Serpentine Green of *flavivertex* which *aurantiivertex* is said to share. The throat is clearer white than in most *flavivertex*, without the grayish tinge of that form, and the under wing-coverts are brownish ochraceous rather than grayish green.

However, the female of *aurantiivertex* is unknown, and there is a slight possibility that the females resemble those of *linteatus* while the males are more like *flavivertex*. Until such possibility is assured, however, the Puerto Indiana female must be referred to *linteatus*.

The young male from the "Upper Amazon," collected by Herndon, is possibly from Perú, since Herndon (1854, 'Explor. Valley Amaz.,' I, p. 271), says that most of his birds, taken before he reached Manaos, came from the neighborhood of Pebas. This specimen agrees with other young males of *linteatus* in most particulars except that a single bright feather appearing on the left side of the crown is nearer orange than red in color, although the basal part of this feather is broadly white as in *linteatus*, not gray as in *flavivertex*. Young males of *linteatus* from other localities have the crest-feathers somewhat more orange-scarlet than the average adult males, but they are still redder than in Herndon's specimen. The dull bronzy olive dorsum, however, agrees with *linteatus* and not with *flavivertex* or, presumably, *aurantiivertex*. The under parts below the dull whitish throat are more deeply cinnamomeous than in the Puerto Indiana female or other females of *linteatus* but paler than in adult males.

There are no definite earlier records of *linteatus* from Perú unless the bird obtained by Bates on the "Upper Amazon" or the type of the species, also from the "Upper branches of the Amazon," came from this country, a not unlikely possibility.

It may be noted here that *flavivertex* has a more extensive range than has been supposed. Specimens are at hand from the right bank of the lower Rio Negro in Brazil, not far above the mouth, and from Faro, somewhat to the eastward.

#### SPECIMENS EXAMINED

*H. linteatus*.—BRAZIL: Rio Tapajoz, Aramanay, 1 ♂, 2 ♀; Igarapé Brabo, 4 ♂, 1 ♀, 1 (?); Igarapé Amorin, 2 ♂; Tauarý, 3 ♂, 3 ♀; Limoãl, 1 ♂; Isla de Goyana, 1 ♂; Isla do Papagaio, 1 ♂; Rio Madeira, Borba, 1 ♂; Humaythá, 3 ♂, 1 ♀; Alliança, 1 ♀; Rio Roosevelt, "Camp 30," 1 ♂; Broken Canoe Rapids, 1 ♀; Teffé, 1 ♂. PERÚ: Puerto Indiana, 1 ♀; ? "Upper Amazon," 1 ♂.

*H. flavivertex*.—BRAZIL: Faro, 2 ♂; Rio Negro, Muirapinima, 3 ♂, 5 ♀; San

Gabriel, 3 ♂, 3 ♀; Camanaos, 1 ♀; Yucabí, 1 ♂; Tatú, 1 ♂. VENEZUELA: Río Cassiquiare, Buena Vista, 1 ♂; Solano, 2 ♂; Río Huayná, junction of Cassiquiare, 4 ♂; terrain between junction of Huayná and Cassiquiare, 1 ♂; Mt. Duida, Caño León, 1 ♀; Río Pescada, 1 ♂; "Primer Campamento," 1 ♂; Río Ocamo, 1 ♀; opposite mouth of Río Ocamo, 1 ♂; Esmeralda, 3 ♀; Ayacucho, 1 ♀; San Fernando de Atabapo, 1 ♂, 1 ♀; Maipures, 6 ♂, 3 ♀; Perico, 2 ♂.



# AMERICAN MUSEUM NOVITATES

Number 890

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY, OCTOBER 31, 1935  
New York City

## RESULTS OF THE ARCHBOLD EXPEDITIONS. NO 12

### ALTITUDINAL VARIATION IN NEW GUINEA BIRDS

By A. L. RAND

#### INTRODUCTION

The study of the bird collection of the American Museum's 1933-1934 Papuan Expedition, sponsored and led by Richard Archbold has brought out the hitherto unrecognized fact that in New Guinea there is considerable geographical variation in certain species of birds which is correlated with altitude.

Altitudinal variation, in which the forms from the higher altitudes are larger and darker, due to the colder and more humid (cloud belt condition) environment, are well known from tropical mountains.

The only undoubted altitudinal races that had been recognized as such in New Guinea were described by Ogilvie-Grant. These are *Collocalia hirundinacea excelsa*, a mountain representative of *C. h. hirundinacea*, and *C. esculenta erwini* (described as *maxima*), a mountain representative of *C. e. esculenta* (1914, Bull. Brit. Ornith. Club, XXXV, pp. 34, 35). Such well-known cases as *Syma megarhyncha* and *S. torotoro*, *Peltops montanus* and *P. blainvillii* are properly species which represent each other at different altitudes.

#### AIM AND SCOPE OF THE WORK

New Guinea is a very mountainous island, with peaks rising to 5000 meters, and it would have been surprising if cases of altitudinal variation and altitudinal representative races did not exist. In the present paper I shall show that altitudinal variation does exist in New Guinea and that in many cases it is in accordance with the rules which appear to govern the same phenomenon in other parts of the world.

The present work is based largely on the bird collection made by the 1933-1934 Papuan Expedition (Richard Archbold and A. L. Rand). A collection made by the The Whitney South Sea Expedition (Mr. Hannibal Hamlin) in southeast New Guinea and a collection made by Mr. J. T. Zimmer in southeast New Guinea were useful in supplying lower altitude specimens. A complete report on these collections by



Dr. E. Mayr and myself is being prepared, and the intention of the present paper is to draw attention to the heretofore overlooked fact that altitudinal variation commonly occurs in New Guinea. My thanks are due to Dr. Mayr for criticisms in preparing this paper.

The present survey covers only part of southeast New Guinea and, in the subsequent discussions, the altitudes used refer to the following areas.

Sea level: chiefly the lowlands near Yule Island, but in a few cases specimens are included which come from between the St. Joseph River and Milne Bay.

770 meters: Deva Deva, Iola and Fane (these localities were collected chiefly by Mr. Hamlin with the aid of natives so that a rather large vertical range was probably covered).

1250	"	Mafulu
1400	"	Bella Vista and Fane
1800	"	Ononge
2000	"	Mt. Tafa, east slope
2400	"	Mt. Tafa, west slope
2800	"	Murray Pass
3600	"	Mt. Albert Edward

Thus, the area discussed is roughly a cross-section of southeast New Guinea from Yule Island to the top of the Wharton Range at Mt. Albert Edward. For a map and description of this area, see 'Results of the Archbold Expeditions, No. 7,' 1935, Bull. Amer. Mus. Nat. Hist., LXVIII, Art. 8.

#### ALTITUDINAL RACES

##### EXAMPLES

A number of altitudinal races have been described in an earlier report by Mayr and Rand ('Results of the Archbold Expeditions, No. 6,' 1935, American Museum Novitates, No. 814), and these, with other races that have been described, are discussed below.

#### GRASSLAND FORMS

*Synoicus ypsilophorus mafulu* Mayr and Rand, from the mountain-valley grasslands between 1000 to 2000 meters. This race is slightly larger, more barred and with less sexual dimorphism than the lowland *plumbeus*.

*Synoicus ypsilophorus monticola* Mayr and Rand, from the alpine grasslands above 2800 meters. This race is distinguished from both *mafulu* and *plumbeus* in being larger, more coarsely barred, lighter in general color and in having the sexual dimorphism still more reduced.

These two forms are especially interesting in that of all the other races of *ypsilophorus*, *mafulu* is most like *australis* of eastern Australia, while *monticola* is most similar to *ypsilophorus* of Tasmania.

*Megalurus timoriensis alpinus* Mayr and Rand, from the alpine grassland above 2800 meters. This race differs from the lowland form *macrurus* in its larger size, heavier markings, grayer flanks and darker rump.

*Megalurus timoriensis macrurus* from 1000 to 2000 meters is not identical with the lowland bird (see below).

*Malurus alboscapulatus mafulu* Mayr and Rand, from the mid-mountain grasslands between 1000 and 2000 meters; this differs from the lowland *naimii* in its larger size and the greater extent of black in the female. This species is broken up into a number of races in New Guinea in which the range of a black-bellied form sometimes separates the range of two white-bellied races, so that the ranges of two very similar white-bellied, forms such as *tappenbeckii* and *alboscapulatus*, are separated by the range of the more different *aida* with a black belly.

*Lonchura caniceps scratchleyana* Sharpe was described in 1889 (Bull. Brit. Ornith. Club, VII, p. 9) but has apparently often been overlooked. From the description it might be confused with *L. c. kumusii* Hartert, but is quite a different looking bird; *kumusii* is simply a paler, grayish-brown race of *caniceps*, while *scratchleyana* is more different. It is paler, more earthy brown and with paler upper tail-coverts than *caniceps* and much more earthy brown than *kumusii*. In size, *scratchleyana* does not differ from *caniceps*.

#### FORMS OF BOTH FOREST AND GRASSLAND

An example of this is *Collocalia esculenta*. The following measurements are given from the material from southeast New Guinea.

	METERS	MALE	FEMALE
<i>erwini</i>	3600	109, 110, 110 mm.	108
<i>esculenta</i>	2800	104, 106	
	2400	104, 104, 105, 106, 107	103, 104, 107
	2000	102, 102, 103	103
	900		109
	450	103	101, 101

This is a bird which lives in the forest as well as about the forest edges and feeds over the edge of the grassland.

A differentiation in both size and color correlated with altitude is suggested in *Collocalia hirundinacea*, but the present material is not

sufficient to be sure of this. Ogilvie-Grant (1914, Bull. Brit. Ornith. Club, XXXV, p. 34) found that in the Snow Mountains the birds from the higher altitudes were different enough from *hirundinacea* of the lowlands to justify separating it as *excelsa*.

#### FOREST FORMS

Our work on the Wharton Range has also established the fact that there are altitudinal races of three forest birds.

*Ptiloprora guisei perstriata* DeVis has usually been synonymized with *guisei*, but actually the name refers to the larger, dark-backed, not rufous-backed, form from the highest altitudes on the Wharton Range where we collected it at 3680 meters. *P. guisei*, with the feathers of the back edged rufous, ranges from 2000 to 2800 meters. In this connection it should be stated here that *perstriata* is very similar to *lorentzi* from the Snow Mountains, and *praedicta* of the Wandammen Mountains, while *guisei* is more similar to the rufous-backed form *umbrosa* of the Sepik Mountain; *mayri* of the Cyclops is somewhat intermediate between the black and rufous-backed forms. This similarity of *perstriata* to *lorentzi* and the greater difference from *guisei* suggests a different history for the higher race, and possibly it has not evolved from the lower ranging *guisei*.

The name *Melidectes leucostephes belfordi* DeVis has usually been considered as applicable to all the southeast New Guinea birds, but from the collections of the 1933-1934 Papuan Expedition it appears to be applicable only to the form from the highest parts of the Wharton Range, which we collected only at 3680 meters on Mt. Albert Edward; this form differs from the lower altitude race (*M. l. brassi* Mayr and Rand) which we found from (1400?) 2000 to 2800 meters, only in its larger size.

	METERS	MALE	FEMALE
<i>belfordi</i>	3680	147, 150, 150, 153, 153 mm.	140
<i>brassi</i>	2800	139	127, 131
	2400		139
	2000	140, 141, 143, 143, 144	127, 130, 131
	1400 (?)	132, 140, 148, 144	123, 127, 137

Judging by the similarity between *brassi* and *belfordi*, and the greater difference from other races of *leucostephes* (a contrast to the condition in *Ptiloprora*) there seems little doubt that one is the ancestor of the other.

*Sericornis nouhuysi monticola* Mayr and Rand, from 3680 meters on Mt. Albert Edward, is distinguished from *oorti* occurring on Mt.

Tafa by its average slightly larger size and its considerably paler, less brown coloration.

#### SUMMARY OF ALL THE ALTITUDINAL RACES

Higher altitudinal races which are larger than their lowland representatives:

*\*Synoicus ypsilophorus mafulu*  
*\*Synoicus ypsilophorus monticola*  
*\*Megalurus timoriensis alpinus*  
*\*Malurus alboscapulatus mafulu*  
*Collocalia esculenta erwini*  
*\*Sericornis nouhuysi monticola*  
*\*Ptiloprora guisei perstriata*  
*Melidectes leucostephes belfordi*

Higher altitudinal races which are darker than their lowland representatives:

*Synoicus ypsilophorus mafulu*  
*Megalurus timoriensis alpinus*  
*Malurus alboscapulatus mafulu*  
*Ptiloprora guisei perstriata*

Highland races which are paler than their lower altitudinal representatives:

*Lonchura caniceps scratchleyana*  
*Synoicus ypsilophorus monticola*  
*Sericornis nouhuysi monticola*

#### ANALYSIS OF THE ABOVE DATA

Of these nine higher altitudinal representatives eight or 88.8 per cent are larger than their representatives from the lower altitudes; four or 44.4 per cent are darker than their lower representatives; three or 33.3 per cent are paler than their lower races; two or 22.2 per cent do not differ in color.

#### ALTITUDINAL VARIATIONS WHICH ARE NOT OF SUBSPECIFIC VALUE

Besides these cases in which the difference between populations from different altitudes is great enough to justify separating them as races, there are a considerable number of cases in which there is a difference correlated with altitude, but it is too slight to be used in recognizing races, or there is too much overlap or intergradation over too great an area.

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\* Differ also in color.

A vertical range of 800 meters is the smallest within which I have found a recognizable variation, so that in the following discussion only forms are included in which we have sufficient material separated by at least 800 meters of altitude. At least two specimens from one extreme and four from the other with regard to comparable age and sex, immature birds being discarded, are considered as sufficient to give an indication of the variation or lack of it, and in most of the cases where variation was found considerably larger series are at hand, as can be seen from the accompanying data. In a few cases where more than the minimum material was present a slight difference in size was indicated, but it did not seem definite enough to list; these cases are excluded from the following tabulations.

#### EXAMPLES

The following are examples of variations which are not great enough to use in separating races.

#### VARIATIONS IN SIZE (WING LENGTH)

##### *Paramythia montium*

METERS	MALE	FEMALE
3680	97, 99, 101, 103, 107 mm.	101, 102, 102, 102
2800	101, 103, 106	94, 100, 100, 102
2400	95, 98, 101, 104, 104	93, 95, 96, 97
2300	103	91

In this case, over a range of 1300 meters, the only difference is one of size, and that is clearly shown only in the female. *Acanthiza murina*, ranging from 2400 to 3680 meters, shows a similar size difference, most noticeable in the female though also evident in the male, as does *Rhipidura brachyrhyncha* and *Ifrita kowaldi*.

In some cases the difference is noticeable in both the male and the female, as in *Pachycephala schlegelii* with a range from 770 to 3680 meters.

METERS	MALE	FEMALE
3680	91, 91, 92, 93, 94 mm.	87
2840	86, 89, 90, 90, 92, 92, 94	87, 88, 89
2400	87	88
2070	86, 86, 87, 88	83, 85, 86, 86
1250	86	
770		83, 86

A similar condition was found to exist in *P. schlegelii* in the Saruwaged Mountains, by tabulating Mayr's data in 1931, Mitt. Zool. Mus. Berlin, XVII, p. 672.

*Crateroscelis robusta* also shows the same thing.

METERS	MALE	FEMALE
3680		60, 63
2860	64, 65, 66, 66 mm.	60, 61, 62, 63
2400	61, 62, 62, 62	59, 60, 60
2000	61, 61, 62, 62, 63, 64	57

In these cases the difference is one of size only.

Similar well-marked cases are *Machaerirhynchus nigripectus*, *Pachycephala rufinucha* and *Peltops montanus*.

In some cases the difference in size is more pronounced in the male, as the following data on *Poecilodryas sigillata* show.

METERS	MALE	FEMALE
3680	100, 100 mm.	93, 94, 96
2840	96, 99	90
2400	92, 92, 93, 93	89, 90, 92, 92

The following are extremes of this type of variation in non-passerine birds:

*Aegotheles insignis*

METERS	MALE	FEMALE
2400	176 mm.	176
1800	171	
1250	162, 170	172, 172

*Macropygia amboinensis*<sup>1</sup>

METERS	MALE	FEMALE
1250	171, 174, 174 mm.	168
450	172	
Near sea level	168, 170	161, 167

*Rallacula forbesi*

METERS	MALE	FEMALE
2800	107, 113, 115, 116, 117, 117 mm.	112, 114, 116
2400	107, 115, 117, 117	
1250	105, 111	
770(?)		108, 109

<sup>1</sup> Mayr, 1931, Mitt. Zool. Mus. Berlin, XVII, p. 707, says that north New Guinea birds of this species from the higher altitudes are darker than lowland specimens.

There are many other cases which suggest the same increase in size with altitude, but the data at hand on these species are too scanty to use in generalizing. This is particularly true of the non-passerine species, in which large series were as a rule not collected.

There is, however, one case (the following) in which the birds from a higher altitude are smaller than those from lower altitudes.

*Pitohui dichrous monticola*

METERS	MALE	FEMALE
1250	106, 108, 109 mm.	106, 106, 107
Near sea level	111, 111	109, 109

This is the only such case that I have seen in the New Guinea collection.

VARIATIONS IN COLOR

The above variations deal only with size. There are also a number of examples of color variation with altitude but no difference in size, of which the following are examples.

*Myiolestes megarhynchus despectus*. Some of the specimens from 1250 meters are much darker, more earthy colored below than the series from sea level while other specimens are identical. There is no average difference in size.

Specimens of *Megalurus timoriensis macrurus* from the 1000–2000 meters mountain grassland are slightly darker and more heavily marked than the lowland birds.

*Pachycephala griseiceps perneglecta*. In this species the birds from 1250 meters have a grayer, less brownish (that is, lighter colored) crown than birds from near sea level.

SUMMARY

A Summary of the Species Which Show Altitudinal Variation within a Subspecies and Those Showing No Variation

In the following lists I have not chosen material from any group or groups of birds, but have included all the species on which I have sufficient data (see above, p. 6, for criterion used in selecting data). Naturally smaller series of the larger species were collected, and though altitudinal variation was indicated in some, it is due to insufficient data that these are not included. Young birds were not used in making comparisons, and due to differences in sex other series were not usable so that in all there are left only sixty species to be used in the following tabulation.

Forms in which representatives from the higher altitudes are larger:

<i>Rallculica forbesi</i>	(770?)	1250-2800 m.
<i>Macropygia amboinensis</i>		6-1250
<i>Aegotheles insignis</i>		1250-2400
<i>Collocalia esculenta esculenta</i>		450-2800
<i>Collocalia vanikorensis</i>		0-1250
<i>Crateroscelis robusta</i>		2000-3600
<i>Ifrita kowaldi</i>		2000-3600
<i>Acanthiza murina</i>		2400-3680
<i>Poecilodryas sigillata</i>		2400-3680
<i>Rhipidura brachyrhyncha</i>		2000-3600
<i>Machaerirhynchus nigrippectus</i>		1250-2400
<i>Peltops montanus</i>		770-2000
<i>Pachycephala schlegeli</i>		2000-3680
<i>Pachycephala rufinucha</i>		770-3680
<i>Paramythia montium</i>		2300-3680

Species in which the higher altitudinal representative is smaller:

<i>Pitohui dichrous</i>	0-1250 m.
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Species in which the higher altitudinal representatives are darker:

<i>Megalurus timoriensis macrurus</i>	0-2000 m.
<i>Myiolestes megarhynchus</i>	0-1250

Species in which the upper population is paler:

The series I have of the following forms do not show altitudinal variation:

<i>Iracidea berigora</i>	100-2400 m.
<i>Ptilinopus pulchellus</i>	0-1250
<i>Ptilinopus rivolii bellus</i>	1250-2800
<i>Ducula chalconota</i>	770-2400
<i>Gymnophaps albertisi</i>	2000-3680
<i>Macropygia nigrirostris</i>	0-1450
<i>Reinwardtoena reinwardtsi</i>	0-1250
<i>Lorius lory</i>	0-1250
<i>Trichoglossus ornatus</i>	0-1450
<i>Oreopsittacus arfaki</i>	2400-3680
<i>Neopsittacus muschenbroekii</i>	1250-2800
<i>Neopsittacus pullicauda</i>	2400-3680
<i>Psittacella picta</i>	2400-3680
<i>Cacomantis castaneiventris</i>	100-1250
<i>Cacomantis pyrrhophanus</i>	2000-2800
<i>Podargus papuensis</i>	0-2000
<i>Aegotheles albertisi</i>	2000-2800
<i>Edolisoma montanum</i>	770-2000



<i>Coracina longicauda</i>	2000-2800
<i>Turdus poliocephalus</i>	2400-3680
<i>Melampitta lugubris</i>	2000-2800
<i>Sericornis papuensis</i>	2000-3680
<i>Phylloscopus trivirgatus</i>	1270-2400
<i>Arses telescopthalmus</i>	0-1250
<i>Rhipidura albo-limbata</i>	2000-3680
<i>Rhipidura atra</i>	1000-2400
<i>Pachycephala modesta</i>	2000-3680
<i>Myzomela rosenbergi</i>	1250-3680
<i>Melipotes gymnops</i>	1250-3680
<i>Melidectes torquata</i>	770-1500
<i>Melidectes fuscus</i>	2800-3700
<i>Melidectes leucostephes brassi</i>	2000-2800
<i>Oreornis subfrenatus</i>	2000-3680
<i>Xanthotis chrysotis</i>	0-1250
<i>Ptiloprora guisei guisei</i>	2000-2800
<i>Dicaeum geelvinkianum</i>	0-1800
<i>Melanocharis nigra</i>	0-1250
<i>Pristorhamphus versterii</i>	1250-3680
<i>Oreocharis arfaki</i>	1250(?) - 2840
<i>Zosterops novaeguineae</i>	1250-2400
<i>Lonchura monticola</i>	2800-3600

## ANALYSIS OF THE ABOVE TABULATION

In all, I have included sixty species of which I have material enough to judge whether or not there is variation correlated with altitude. Of these, nineteen species or 31.6 per cent show some variation; in 15 or 25 per cent of the total number of species examined there is an increase in size with altitude; in two cases or 3.3 per cent of the total the representatives from the higher altitudes are darker. In only one case, 1.6 per cent, are the higher altitude specimens smaller. In one case, 1.6 per cent, the higher altitude specimens are a paler color. Of the sixty species discussed, seventeen, or 28.3 per cent, show an increase in size or in pigmentation with increase in altitude, while in only two, or 3.3 per cent, of the cases is the reverse true.

The altitudinal variation is more common in the passerine birds:

	SHOWING VARIATION	NOT SHOWING VARIATION
Non-passerine forms	5 (distributed in 4 families)	17 (in 7 families)
Passerine forms	14 (in 6 families)	24 (in 10 families)

Thus, of the twenty-two non-passerine forms, five, or 22.7 per cent, of them show altitudinal variation, and this is in size only; of the thirty-

eight passerine birds, fourteen, or 36.8 per cent, show altitudinal variation.

#### DISCUSSION

The races of grassland species have the ranges of the different populations at different altitudes quite separate; the grasslands and savannas of the lowlands, the mountain-valley grasslands, from 1000 to 2000 meters, and the alpine grasslands above 2800 meters are separated from each other by belts of forest. Since the ranges are not continuous, intergradation is possible only through individual variation.

That the isolation of these grasslands by forest barriers is the sole factor involved is unlikely when we consider that birds less restricted to grasslands also show size differences correlated with altitude.

The two honey eaters with altitudinal races are both forest birds with a continuous range in the continuous forest from 2000 to 3680 meters, and yet both range from 2000 meters on the mountain slopes to 2800 meters on top of the Wharton Range unchanged, without a progressive differentiation as the altitude increased, while the forms found on Mt. Albert Edward at 3680 meters (and probably on other isolated mountain peaks in southeast New Guinea which rise to sufficient height, as the types of *P. g. perstriata* and *M. l. belfordi*, come from Mt. Knutsford to the southeast of Mt. Albert Edward) are definitely different, suggesting a sudden change from one form to the other or a narrow area of intergradation.

*Sericornis nouhuysi* is also a forest bird with a continuous vertical range, but in this form 2800 meters is in the area of change between the two races. Most of the specimens from 2800 meters are definitely referable to *oorti*, some with a slight tendency toward *monticola*, while two of them are definitely *monticola*. This suggests that the area of intergradation between these two forms may be very narrow, if we consider that a 100 meter vertical range from the camp altitude was collected over, and the typical *monticola* may have come from the upper part of this range.

This is in contrast to the case of *Collocalia esculenta* (see above), in which there is a gradual increase in size until the extreme in size, from the highest altitude, may be recognized as a slightly differentiated mountain race.

In variations not great enough to be of subspecific value which show an increase in size with increase in altitude, sometimes more pronounced in one sex than the other, sometimes noticeable in both, there is, in the

cases on which I have data, a gradual change in size; that is, there is no sharp, sudden change from a population of one size to that of another size.

This appears to be different from the above mentioned cases of altitudinal races, where the change may be sudden, but is similar to the condition in *Collocalia esculenta* with a slightly differentiated mountain race.

In the above I have set forth a number of slight variations correlated with altitude and a number of altitudinally representative subspecies. These largely conform to the Bergmann rule. These should be the forerunners of species, and should give an idea of one manner in which mountain species may originate.

Dr. Chapman, in his most recent work on the distribution of birds in South America (1931, Bull. Amer. Mus., LXIII, pp. 40-41), states that the mountain forms on Roraima and Duida Mountains are usually larger and darker than their assumed ancestors, in conformation to the laws that species increase in size with higher altitudes, and become darker in color with greater humidity. He further holds that whatever the process which accomplishes this, it is apparently started by the influence of environment.

Bates (1931, Ibis, pp. 255-300) has pointed out that certain small variations correlated with altitude occur in the mountains of west Africa; but Chapin, in his study of the African montane avifauna (1932, Bull. Amer. Mus., LXV, pp. 285-300), finds few montane species which appear to have been derived from present lowland forms. Chapin is of the opinion that heredity and mutation, with the aid of isolation, determine how the bird will vary, and climate acts only as a selective factor.

In New Guinea the populations at different altitudes, which differ slightly from each other, are presumably the forms which have only recently begun to vary. They have not yet had time to evolve further. We should also expect to find in New Guinea, an island which has had time to develop a very peculiar montane fauna, a series of closely related altitudinally representative species. But it is impossible to find many of them. In the genera such as *Pachycephala*, *Poecilodryas*, *Myzomela*, *Rhipidura* and *Gerygone* with representatives from sea level to timber line, it is impossible to find lowland forms from which the montane species really appear to have been derived. There are a few exceptions such as occur in the genera *Peltops* and *Syma*, but there are also examples of species with altitudinally overlapping ranges which are just as similar (such as *Erythrura*, *Collocalia* and *Neopsittacus*) or very similar species

with the same vertical range (as in *Meliphaga*). The chains seem to be broken here. There is no series to show that the influence of altitude on climate has brought about the evolution of mountain species along certain lines. There are many very distinct mountain forms, but most of them are not closely enough related to existing lowland forms to be able to point out their ancestry.

#### SUMMARY

Altitudinal variation within a species is a common phenomenon in the mountains of southeast New Guinea. It occurs both in species inhabiting areas of grassland isolated at different altitudes by forest belts and in birds inhabiting the forest which is continuous from one altitude to another.

In nine cases these differences are great enough to use in recognizing races; in nineteen cases these differences are not great enough or there is too great an area of intergradation or overlap to characterize races. In forty-one species in which I have enough material to arrive at a conclusion, there is no altitudinal variation.

Increase in size, correlated with increased altitude and consequently lowered temperatures, is the most common type of variation (in eight races and fifteen cases of smaller variation); there was only one race which showed no size variation and one case in which the higher altitudinal population was smaller.

Variation of pigmentation was found in seven races and in only three cases within subspecies. Increased pigmentation is usually associated with increased humidity so that only the Subtropical Zone forms would be expected to be darker. This is true in *Sericornis nouhuysi*, with a paler Upper Temperate Zone race, but is not the case with *Ptiloprora guisei*, though here other factors may come in. With the other races there does not seem to be a definite general tendency toward lightness or darkness with increase in altitude. Possibly when the climatic conditions in the mountains of southeast New Guinea are known this may help to explain the variation in pigmentation.

Though I have few examples, the forest species which have evolved very distinct races at different levels in the continuous forest show a sudden change from one form to the other, as though the cumulative effect of the environment reached a threshold level, beyond which the change was sudden. The grassland races are isolated, so this criterion cannot be applied to them. The one species in which the races are

slightly differentiated (*Collocalia esculenta*) shows a gradual change with increased altitude.

In the forms with variations insufficient to recognize as races there is a gradual variation with altitude.

The exact levels to which the grassland races are restricted in part may be due only indirectly to climate acting on the vegetation. Temperature appears to be the single factor which changes most constantly in reference to altitude, and however the result is produced the larger size of the higher altitudinal populations appears correlated with the lower temperatures. This appears to be true only for minor variations, the most extreme of which form well-marked races.

Variation does not appear to be restricted to any one vertical level but may appear within almost any range of altitude, though in the present work it was not perceptible in less than 800 meters of altitude.

#### CONCLUSIONS

Lower temperature, caused by increased altitude, is in many species correlated with the increased size of the higher altitudinal representative of the same species or race of bird. The effect of varying humidity, caused by different conditions in the mountains, if such exist, cannot be evaluated.

When small differences exist between altitudinal representatives there tends to be gradual intergradation; when greater differences, as between well-marked races, are present, the change appears more abrupt, suggesting that here we have the forerunners of species. But species within a genus do not show such correlations. Usually there appears to be no correlation between the montane and lowland species of the same genus to suggest that the mountain species have evolved from the present lowland forms.

This suggests that the differences between altitudinally representative populations within a species, and that between altitudinally representative species, is more than one of degree only; that altitudinally representative species are not brought into being by only a continuation of the action of the forces which produced subspecies. Birds are restricted to certain levels on the mountain slopes, possibly through temperature, and this isolation allows species and genera to evolve independently at different altitudes. Climatic factors may perhaps speed up these changes, but the resultant variations are not as closely correlated with the lowered temperature as are the minor variations within species.





# AMERICAN MUSEUM NOVITATES

Number 891

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

Nov. 3, 1936

## SOME HAMILTON OSTRACODES FROM ARKONA, ONTARIO

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### INTRODUCTION

The ostracodes described in this paper were collected by the senior author in 1930, from Marsh's Mill and Rock Glen, on the Ausable River, about one and one-half miles east of Arkona, in the southeastern part of Bosanquet Township, Lambton County, Ontario. The sample comes from the Coral Zone of the Widder Beds in the Hamilton Group, just above the Encrinal Limestone which separates the Widder Beds from the Arkona shale.

The Coral Zone is a bluish or gray shale or shaly limestone, abundantly fossiliferous. The Widder Beds, of which it is the chief fossiliferous member, are equivalent to the Ludlowville Formation of the Hamilton at Eighteen Mile Creek, New York. They possess a common fauna, which is also present in Michigan, in the upper part of the Alpena Limestone, in the Traverse Group.<sup>2</sup>

The ostracodes from the Coral Zone which are included in this paper are classified in 22 genera, 10 of which are new. There are 34 species, of which 24 are new. Two new families, the Ropolonellidae and Quasillitidae, are named and described here for the first time. They include an original list of four genera each.

Appreciation is due to Mr. Philip H. Jennings for helpful service in photography.

### CLASSIFICATION AND DESCRIPTION OF THE OSTRACODA

#### **Primitiidae** Ulrich and Bassler, 1908

##### **ULRICHIA** JONES, 1890

##### **Ulrichia spinifera**, new species

##### Figures 1, 1a, 2

Carapace subrhomboidal; hinge line straight, about seven-eighths as long as the greatest length of the valve. Cardinal angles sharp, slightly obtuse. Ventral mar-

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<sup>2</sup> Stauffer, C. R., 1915, 'The Devonian of Southwestern Ontario.' Canada Dept. of Mines, Geol. Surv., Mem. 34, p. 10



gin gently convex; ends rounded, with slight backward swing near the anterior. Free margin surrounded by a heavy false border with very small, regularly spaced, spinose papillae projecting from its outer edge. Surface of each valve within the thickened marginal ridge is flattened and ornamented with reticulations and two non-reticulate tubercles that extend above the hinge line, one near the center of the posterior half of the dorsal margin, and the other posterior to the center of the anterior half of that border. The anterior tubercle is sharper than the posterior one. Greatest height is located slightly anterior to the mid-height of the posterior half.

LENGTH.—0.74 mm. HEIGHT.—0.41 mm.

TYPES.—A. M. N. H. Cat. No. 24628.

This species is distinguished from *Ulrichia conradi* Jones, by its more elongate form, and by the presence of the conspicuous spinose papillations along the free margin.

**BOLLIA JONES AND HOLL, 1886**

***Bollia widerensis*, new species**

Figures 4, 4a

Carapace subovate; hinge line straight, with obtuse cardinal angles. Ventral margin broadly convex; anterior margin broadly rounded both dorsally and ventrally, forming a medially protruding central portion; apparently a slight backward swing anteriorly. Posterior end rounded with higher, smaller arc, more protruding. Shell apparently thick, the thickness increasing toward the ventral margin. The submedian sulcus, which is located slightly posterior to the center of the valve, is bounded by a U-shaped ridge, broad anteriorly and narrow posteriorly. The anterior and posterior limb of the ridge each ends in a blunt, broad-based, dorsal cone. The anterior cone is round in cross section and rises higher and is more acute than the posterior one, and it is as wide as the ridge. The posterior cone is more lobe-like, with an oval base which has its longer axis nearly normal to the hinge line. This lobe is wider than the U-shaped ridge and joins it on its posterior edge. This makes the median sinus curve backward around the ventral edge of the lobe. The U-shaped ridge is separated ventrally from the rest of the valve by a depression that is deep, and equal in width to the width of the ridge posteriorly. As it approaches the anterior, the groove becomes increasingly narrow and more shallow, so that the anterior limb of the U-shaped ridge is almost flush, along its outer margin, with the anterior two-fifths of the valve. Surface of carapace is coarsely papillose. Greatest height is located two-fifths of the length from the anterior end; greatest convexity is postero-ventral.

LENGTH.—1.59 mm. HEIGHT.—0.91 mm.

TYPES.—A. M. N. H. Cat. No. 24627.

*Bollia widerensis* is more elongate than *Bollia hindei* Jones.

**Bollia hindei Jones, 1890**

Figure 3

JONES, T. R., 1890, Quart. Jour. Geol. Soc. London, XLVI, p. 540, Pl. xx, fig. 5.

LENGTH.—1.3 mm. HEIGHT.—0.8 mm.

PLESIOTYPES.—A. M. N. H. Cat. No. 24610.

This specimen resembles very closely that figured by Jones in 1890 from Eighteen Mile Creek, New York, but the orientation has been reversed.

**Beyrichiidae** Ulrich, 1894 (1897)

**CTENOLOBOLINA** ULRICH, 1890

**Ctenobolbina papillosa** Ulrich, 1891

Figure 8

ULRICH, E. O., 1891, Jour. Cin. Soc. Nat. Hist., XIII, No. 4, p. 186, Pl. xv, figs. 8 a-c.

LENGTH.—1.25 mm. HEIGHT.—0.94 mm.

PLESIOTYPES.—A. M. N. H. Cat. No. 24614.

Well-preserved specimens of this species are common in the Widder Horizon.

**TETRADELLA** ULRICH, 1890

**Tetradella cicatrosa** Warthin, 1934

Figure 9

WARTHIN, A. S., 1934, Contrib. Mus. Paleo., Univ. Mich., IV, No. 12, p. 209, Pl. I, figs. 4-6.

LENGTH.—1.28 mm. HEIGHT.—0.78 mm.

PLESIOTYPES.—A. M. N. H. Cat. No. 24615.

The specimens from Arkona consistently show a much more oblique backward swing than do those figured by Warthin from the Michigan Traverse. Their similarity in all other respects leads one to consider them conspecific.

**RICHINA, NEW GENUS**

**GENOTYPE.**—*Richina truncata*, new species.

Carapace subovate; hinge line straight; ventral margin convex; ends rounded, anterior end with a backward swing. Right valve overlaps the left. A median sulcus is bounded by nodes, or blunt spines, or a node and a spine. Surface of valve smooth, or very finely punctate, or finely reticulate.

This genus differs from *Ulrichia* in the absence of the marginal ridge, and of the coarsely reticulated surface, and in the overlap of the right over the left valve.

***Richina truncata*, new species**

Figures 5, 5a, 6

Carapace subovate; hinge line straight, with obtuse cardinal angles. The posterior one-third of the dorsal margin is obliquely truncated; ventral margin convex; ends rounded, the anterior end with an oblique backward swing. The right valve is slightly larger than the left, overlapping most conspicuously on the posterior and ventral margins. A well-defined submedian sulcus, located slightly anterior to the center of the valve, is bounded anteriorly by a node, and posteriorly by a spine. The

node is located near the central part of the dorsal anterior half of the valve; the spine is located in the line of the maximum height of the valve, just below the dorsal margin. The valves are gently swollen just ventral to the submedian sulcus. Surface of valves is very finely granulated. Greatest height is located about one-third of the length from the posterior end; height of anterior end much less than posterior; greatest convexity anterior to center.

LENGTH.—0.84 mm. HEIGHT.—0.52 mm.

TYPES.—A. M. N. H. Cat. No. 24612 (Fig. 6); A. M. N. H. Cat. No. 24611 (Fig. 5, 5a).

### *Richina subcircularis*, new species

#### Figure 7

Carapace subcircular; hinge line straight, about two-thirds as long as the valve; cardinal angles broadly obtuse. Ventral margin convex; ends rounded, both with the same radius of curvature; very slight backward swing anterior. Right valve overlaps the left on free margins. Well-defined median sulcus is bounded anteriorly by a well-rounded node, and posteriorly by a blunt spine, smaller than the node. Greatest height is posterior to the center, through the spine; greatest convexity is central where the valves swell slightly, ventral to the median sulcus. Surface finely granulated.

LENGTH.—0.85 mm. HEIGHT.—0.6 mm.

TYPES.—A. M. N. H. Cat. No. 24613.

This species differs from *Richina truncata* in having a comparatively greater height in proportion to the length.

### Kirkbyidae Ulrich and Bassler, 1906

#### AMPHISSITES GIRTY, 1910

#### *Amphissites diadematus* Van Pelt, 1933

#### Figure 10

VAN PELT, H., 1933, Jour. Paleo., VII, p. 329, Pl. xxxix, figs. 8-15.

LENGTH.—1.05 mm. HEIGHT.—0.67 mm.

PLESIOTYPES.—A. M. N. H. Cat. No. 24616.

Several specimens of this species have been found in the Arkona collection.

### *Amphissites simplicissimus* Knight, 1928

#### Figures 11, 11a

KNIGHT, J. B., 1928, Jour. Paleo., II, No. 3, pp. 266, 267, Pl. xxxii, figs. 11 a-d; Pl. xxxiv, fig. 6.

LENGTH.—0.4 mm. HEIGHT.—0.28 mm.

PLESIOTYPES.—A. M. N. H. Cat. No. 24617.

This is a rather elongate example of the species.

**Amphissites conatus**, new species

Figures 12, 12a

Carapace subrectangular; hinge line straight; cardinal angles obtuse. Ventral margin broadly convex; ends rounded, anterior with very slight backward swing. Valves apparently equal, with flattened keel along free margins. A conical node lies in a slightly depressed area anterior to the center of the valve, and projects out from the surface just ventral to the dorsal margin. Entire surface is reticulate, with occasional very small spinose papillae. Greatest convexity is central; greatest height is about one-third the length from the posterior margin; but the rest of the height does not vary much from this.

LENGTH.—0.5 mm. HEIGHT.—0.33 mm.

TYPES.—A. M. N. H. Cat. No. 24618.

**KIRKBYELLA CORYELL AND BOOTH, 1933****Kirkbyella unicornis**, new species

Figure 13

Carapace subrhomboidal; hinge line straight, almost equal in length to the length of the carapace. Cardinal angles slightly obtuse; ventral margin straight with ends rounded; extremities of valve gently convex. Sulcus with small circular pit at base, slightly posterior to the middle of the valve. Small blunt spine near the anterior end of the carapace, about one-fourth of the height above the ventral margin; a very inconspicuous ridge-like elevation extends from this for a short distance towards the posterior. Entire surface is reticulated. Height of valves nearly uniform for central three-quarters; convexity fairly uniform throughout.

LENGTH.—0.72 mm. HEIGHT.—0.38 mm.

TYPES.—A. M. N. H. Cat. No. 24619.

**Thlipsuridae** Ulrich, 1894 (1897)**STREPULITES**, NEW GENUSGENOTYPE.—*Strepulites mooki*, new species.

Valves reniform or subovate, unequal; right valve larger. Dorsal margin convex; ventral margin concave centrally or straight; ends of valves rounded. Valves ornamented by narrow ridges somewhat paralleling the margins.

*Octonaria quadricostata* Van Pelt and *O. crescentiformis* Van Pelt are included in this genus.

**Strepulites mooki**, new species

Figure 14

Valves reniform, unequal, right valve overlapping the left on the entire margin. Dorsal margin convex; ventral margin concave centrally becoming convex toward the ends; end margins rounded. Ventral contact with slight central sinuosity. Contact is formed by a ridge in the left valve which fits into a groove in the right. Carapace ornamented by a pair of ridges irregularly parallel to each other and to the anterior, dorsal, posterior, and a small portion of the ventral-posterior margins. The ends of the ridges are united by a longitudinal ridge lying in the ventral half of the valve which slopes upward toward the posterior border until the posterior ridge is

reached. Greatest height and convexity are located in the posterior half; greatest length central, parallel to the ventral margin.

LENGTH.—1.08 mm. HEIGHT.—0.59 mm.

TYPES.—A. M. N. H. Cat. No. 24626.

### Ropolonellidae, new family

This family includes straight-hinged, subtriangular Ostracoda, with more or less ornamented carapaces; the right valve appears to be usually larger than the left. Contact of valves rabbetted; ridge in the left valve fits into a groove in the right.

#### ROPOLONELLUS Van Pelt, 1933

##### *Ropolonellus papillatus* Van Pelt, 1933

Figure 15

VAN PELT, H., 1933, Jour. Paleo., VII, No. 3, p. 339, Pl. XXXIX, figs. 29, 30.

Carapace subtriangular; hinge straight; ventral margin converges towards dorsal margin anteriorly. Anterior end with several small spinose papillae on thickened area of projecting margin. Papillose spines project from the posterior marginal ridge also. Right valve overlaps left on entire margin. Contact rabbetted.

LENGTH.—0.70 mm. HEIGHT.—0.40 mm.

PLESIOTYPES.—A. M. N. H. Cat. No. 24620.

#### RUDDERINA, NEW GENUS

GENOTYPE.—*Rudderina extensa*, new species.

Carapace suboblong; hinge line straight, of the ridge and groove type; ventral margin nearly straight to slightly convex, rounded where it joins the extremities; end margins of valves somewhat irregularly rounded in lateral view. Right valve overlaps the left on entire margin. Anterior and posterior of one or both valves extended, near the ventral margin into spines. Greatest height and thickness located about one-fourth of the length from the posterior end. Anterior height about two-thirds of the posterior height.

##### *Rudderina extensa*, new species

Figure 16

Carapace suboblong; hinge straight; ventral margin slightly convex near the ends and concave centrally; sharply rounded where it joins the extremities; end margins of valve rounded, the posterior more broadly than the anterior. Cardinal angles gently obtuse. Right valve overlaps the entire margin of the left valve, with overlap greatest on ventral edge; contact rabbetted. Anterior and posterior of both valves extended near the ventral margin into prominent spines. Surface of valves finely papillose with some scattered larger granules, more abundant in the anterior half. Greatest height and convexity are located about one-fourth of the length from the posterior end. Anterior height about two-thirds of the posterior height. A gentle ridge like swelling, with an adjacent shallow sinus is observable, extending from the posterior extremity of the hinge, downward and forward, and disappearing in the area of maximum convexity near the ventral border.

LENGTH.—0.93 mm. HEIGHT.—0.45 mm.

TYPES.—A. M. N. H. Cat. No. 24625.

*EUGLYPHELLA* WARTHIN, 1934

*Euglyphella sigmoidalis* (Jones), 1890

Figure 17

*Strepula sigmoidalis* JONES, 1890, Geol. Soc. London, Quart. Jour., XLVI, p. 11, Pl. II, fig. 4.

*Euglyphella sigmoidalis* WARTHIN, A. S., 1934, Contr. Mus. Paleo., Univ. Mich., IV, No. 12, p. 220, Pl. I, fig. 21.

Carapace ornamented by characteristic sigmoid branching carinae, with a row of papillae projecting from the anterior end. Right valve overlaps left on entire margin and is grooved to receive the left.

LENGTH.—1.02 mm. HEIGHT.—0.63 mm.

PLESIOTYPES.—A. M. N. H. Cat. No. 24621.

*Euglyphella projecta*, new species

Figure 18

Carapace subrhomboidal; dorsal and ventral margins straight, and converging anteriorly; posterior end broadly rounded; anterior acutely extended. Valves ornamented by the outer and inner looped carinae apparently more elongate and narrow than in the other species, with the ridges joining anteriorly. The lower tangential juncture extends anteriorly in a sharp and high ridge that approximately parallels the anterior margin, raised almost to spine-like proportions. This joins the dorsal ridges. This species has the free margins produced, anteriorly and posteriorly into narrow marginal flanges. The anterior flange is broader than the posterior. The coarse reticulations are few and inconspicuous in the area surrounded by the loops. The larger right valve is grooved to receive the margins of the smaller left valve.

LENGTH.—0.83 mm. HEIGHT.—0.46 mm.

TYPES.—A. M. N. H. Cat. No. 24622.

*Euglyphella compressa*, new species

Figure 19

Carapace subtriangular; hinge line straight; dorsal margin arcuate; ventral margin straight, convex where it joins posterior end, and slightly angular at the junction. Anterior end is flanged and spinose. The posterior height is nearly three times the anterior height. Valves quite convex, compressed just inside of the anterior marginal flange. Surface carinated with an outer and an inner loop; the outer one approximately parallels the dorsal, posterior and part of the postero-ventral margins; the ventral limb of the inner loop joins the ventral limb of the outer carina tangentially; and the dorsal limb of the inner loop curves to meet the dorsal limb of the outer one, leaving the inclosed area apparently open antero-ventrally. The area between the loops and the interior of the inner loop is coarsely reticulate. A single spine is present on the dorsal carina at the anterior end. Right valve is larger than left, and is grooved to receive the margins of the left valve.

LENGTH.—1.05 mm. HEIGHT.—0.55 mm.

TYPES.—A. M. N. H. Cat. No. 24624.

**Euglyphella jenningsi**, new species

Figure 20

Carapace ovate; hinge straight, with slightly arcuate dorsal margin extending above the hinge line. Ventral margin concave centrally and somewhat so anteriorly, convex posteriorly; the anterior margin is truncated so that it joins with the dorsal and ventral margins in an angular manner. Right valve is larger than the left and is bordered by a marginal ridge; right valve is grooved to receive the left. Valves are ornamented by the outer and inner loops, the inner loop widely open antero-ventrally, and the outer loop quite inconspicuous in the postero-dorsal region. The inclosed area between the loops appears open anteriorly where the ridges rise into spines. Coarse reticulations in two rows of irregular sized depressions cover the anterior and posterior ventral portions of the inclosed area; the dorsal posterior portion contains a larger depression that includes several smaller ones.

LENGTH.—0.89 mm. HEIGHT.—0.54 mm.

TYPES.—A. M. N. H. Cat. No. 24623.

**BUFINA**, NEW GENUSGENOTYPE.—*Bufina elata*, new species.

Carapace subovate; dorsal margin straight; ventral margin convex; ends rounded, anterior end with a backward swing. Surface is ornamented by two anterior spines and a posterior ridge, paralleling the posterior margin. Small papilla-like spines may or may not be present on the end margins. Contact of valves rabbetted; right valve larger than left.

*Moorea bicornuta* Ulrich, 1891, is included in this genus.

**Bufina elata**, new species

Figure 22

Carapace subovate; dorsal margin straight; cardinal angles obtuse; ventral margin angularly convex, with greatest extension just posterior to the center. Ends rounded, anterior more blunt than posterior; anterior with slight backward swing. Contact of the valves is finely toothed; ridge in left valve fits into groove in right. Surface ornamented by two blunt anterior spines that project outward and forward, and a prominent, narrow, posterior ridge, near to and approximately paralleling the posterior margin. A shallow depression lies within the crescent of, and anterior to, the ridge. Numerous tiny spines project from the posterior margin. Greatest height is just posterior to the center; greatest convexity about central; greatest length midway between the dorsal and ventral margins.

LENGTH.—0.78 mm. HEIGHT.—0.53 mm.

TYPES.—A. M. N. H. Cat. No. 24629.

*Bufina elata* is shorter and higher than *Bufina bicornuta* (Ulrich), with the location of the greatest length lower than in *B. bicornuta*. In *B. elata* the anterior end is higher than the posterior; the reverse is true of Ulrich's species.

***Bufina elongata*, new species**

## Figure 21

Carapace elongate, ovate; dorsal margin straight; anterior cardinal angle gently obtuse; posterior cardinal angle more obtuse than anterior. Ventral margin oblique slightly convex; ends rounded, anterior with oblique backward swing; posterior end extended near the ventral border. Surface ornamented by two blunt anterior spines and a submarginal posterior ridge. Right valve larger than left; contact rabbetted. Greatest height is located one-fourth of the length from the posterior margin; greatest convexity central; greatest length below the median line.

LENGTH.—0.85 mm. HEIGHT.—0.46 mm.

TYPES.—A. M. N. H. Cat. No. 24630.

This species is more elongate, and the greatest height is much farther posterior than in any of the species so far described (*B. elata*, *B. bicornuta*).

**Bairdiidae Sars, 1887****BAIRDIA McCoy, 1844*****Bairdia summacuminata*, new species**

## Figure 23

Carapace bairdioid, elongate ovate; ends highly acuminate, curving dorsad, the posterior end more spine-like than the anterior. Dorsal margin high arcuate; ventral margin regularly and broadly convex, except centrally where it is nearly straight. Overlap of left over right valve on entire margin, but most pronounced dorsally. Greatest height and convexity are central. Surface very finely punctate.

LENGTH.—1.44 mm. HEIGHT.—0.65 mm.

TYPES.—A. M. N. H. Cat. No. 24631.

**BAIRDITES, NEW GENUS**

GENOTYPE.—*Bairdites deltasulcata*, new species.

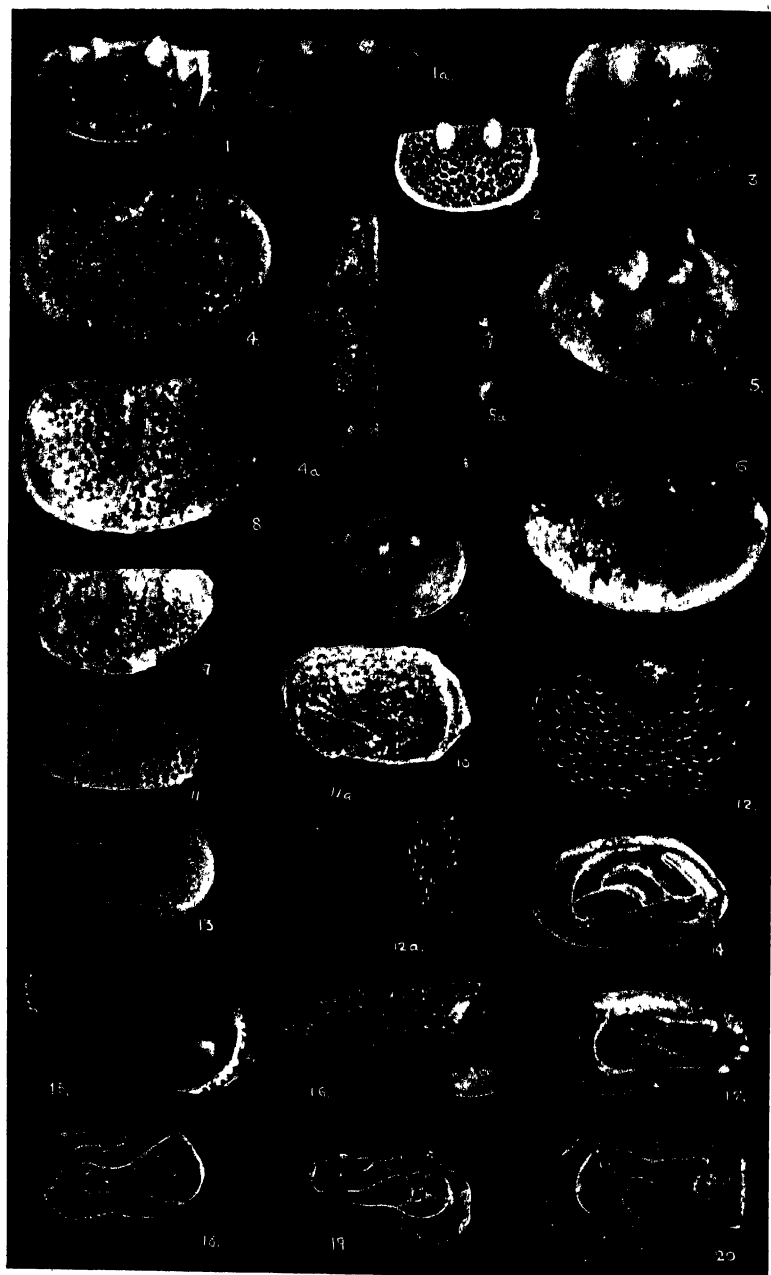
Carapace of characteristic *Bairdia* shape. This genus is differentiated from *Bairdia* by the presence of a posterior depression, bounded by a semi-circular ridge opening anteriorly.

***Bairdites deltasulcata*, new species**

## Figure 24

Carapace subtriangular; dorsal margin highly convex, becoming slightly concave where the posterior two-fifths of the margin slopes to the posterior end. Hinge line straight, located in the posterior half of the valve, equal in length to about one-half the length of the valve; hinge rabbetted. Ventral margin straight, or slightly sinuate; anterior end bluntly rounded, with greatest extension below the median line; posterior end acuminate, turning slightly upward. Left valve overlaps right, apparently on all margins. (The type specimen appears somewhat distorted); overlap greatest along the mid-dorsal and ventral regions. About one-fourth of the length from the posterior end of each valve, the surface rises to a small semi-circular ridge, facing anteriorly, with a shallow depression inside the ridge. Greatest height

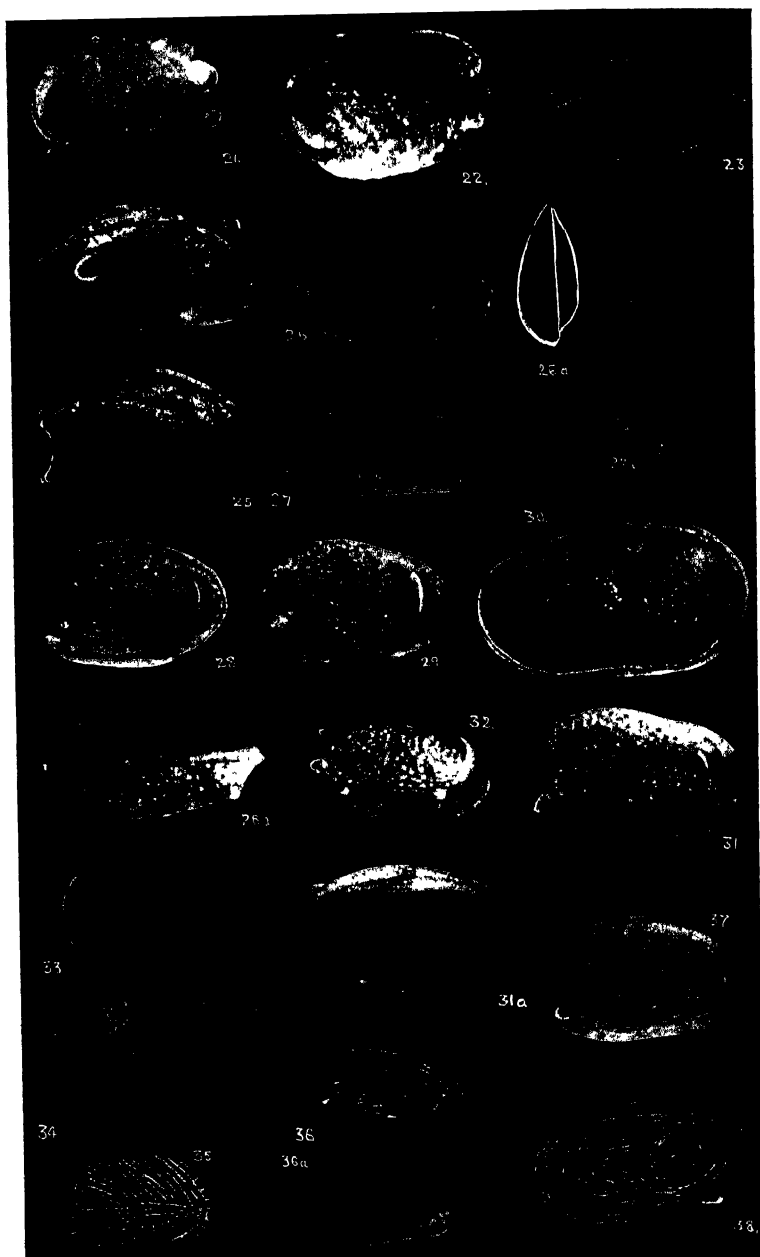




See opposite page for captions.

(Captions for Figures 1-20)

- Fig. 1. *Ulrichia spinifera*, n.sp. Left valve.  $\times 35$ . A.M. No. 24628.  
Fig. 1a. *Ulrichia spinifera*, n.sp. Ventral.  $\times 25$ .  
Fig. 2. *Ulrichia spinifera*, n.sp. Restoration of surface.  
Fig. 3. *Bollia hindei* Jones. Right valve.  $\times 20$ . A.M. No. 24610.  
Fig. 4. *Bollia widderensis*, n.sp. Left valve.  $\times 20$ . A.M. No. 24627.  
Fig. 4a. *Bollia widderensis*, n.sp. Dorsal.  $\times 25$ .  
Fig. 5. *Richina truncata*, n.gen., n.sp. Left valve.  $\times 40$ . A.M. No. 24612.  
Fig. 5a. *Richina truncata*, n.gen., n.sp. Dorsal.  $\times 40$ .  
Fig. 6. *Richina truncata*, n.gen., n.sp. Another specimen. Left valve.  $\times 40$ .  
A.M. No. 24611.  
Fig. 7. *Richina subcircularis*, n.sp. Left valve.  $\times 20$ . A.M. No. 24613.  
Fig. 8. *Ctenobolbina papillosa* Ulrich. Right valve.  $\times 25$ . A.M. No. 24614.  
Fig. 9. *Tetradella cicatrosa* Warthin. Right valve.  $\times 20$ . A.M. No. 24615.  
Fig. 10. *Amphissites diadematus* Van Pelt. Left valve.  $\times 25$ . A.M. No. 24616.  
Fig. 11. *Amphissites simplicissimus* Knight. Left valve.  $\times 55$ . A.M. No. 24617.  
Fig. 11a. *Amphissites simplicissimus* Knight. Ventral.  $\times 45$ . A.M. No. 24617.  
Fig. 12. *Amphissites conatus*, n.sp. Right valve.  $\times 65$ . A.M. No. 24618.  
Fig. 12a. *Amphissites conatus*, n.sp. Ventral.  $\times 45$ . A.M. No. 24618.  
Fig. 13. *Kirkbyella unicornis*, n.sp. Left valve.  $\times 35$ . A.M. No. 24619.  
Fig. 14. *Streptulites mooki*, n.gen., n.sp. Left valve.  $\times 25$ . A.M. No. 24626.  
Fig. 15. *Ropolonellus papillatus* Van Pelt. Left valve.  $\times 45$ . A.M. No. 24620.  
Fig. 16. *Rudderina extensa*, n.gen., n.sp. Left valve.  $\times 40$ . A.M. No. 24625.  
Fig. 17. *Euglyphella sigmoidalis* (Jones). Right valve.  $\times 25$ . A.M. No. 24621.  
Fig. 18. *Euglyphella projecta*, n.sp. Right valve.  $\times 35$ . A.M. No. 24622.  
Fig. 19. *Euglyphella compressa*, n.sp. Left valve.  $\times 25$ . A.M. No. 24624.  
Fig. 20. *Euglyphella jenningsi*, n.sp. Right valve.  $\times 30$ . A.M. No. 24623.



See opposite page for captions.

(Captions for Figures 21-38)

- Fig. 21. *Bufina elongata*, n.sp. Right valve.  $\times 35$ . A.M. No. 24630.
- Fig. 22. *Bufina elata*, n.gen., n.sp. Right valve.  $\times 45$ . A.M. No. 24629.
- Fig. 23. *Bairdia summacuminata*, n.sp. Right valve.  $\times 25$ . A.M. No. 24631.
- Fig. 24. *Bairdites deltasulcata*, n.gen., n.sp. Right valve.  $\times 20$ . A.M. No. 24632.
- Fig. 25. *Healdia arkonensis*, n.sp. Right valve.  $\times 35$ . A.M. No. 24633.
- Fig. 26. *Cavellina subplana*, n.sp. Right valve.  $\times 50$ . A.M. No. 24637.
- Fig. 26a. *Cavellina subplana*, n.sp. Dorsal.  $\times 30$ . A.M. No. 24637.
- Fig. 27. *Cavellina cuneata*, n.sp. Right valve.  $\times 45$ . A.M. No. 24636.
- Fig. 27a. *Cavellina cuneata*, n.sp. Ventral.  $\times 48$ .
- Fig. 28. *Ponderodictya bispinulata* (Stewart). Right valve.  $\times 20$ . A.M. No. 24638.
- Fig. 28a. *Ponderodictya bispinulata* (Stewart). Dorsal.  $\times 25$ .
- Fig. 29. *Ponderodictya bispinulata* (Stewart). Another specimen. Right valve.  $\times 20$ . A.M. No. 24638.
- Fig. 30. *Ponderodictya bispinulata* (Stewart). Interior of right valve.  $\times 25$ . A.M. No. 24638.
- Fig. 31. *Ponderodictya unicornis* (Van Pelt). Right valve.  $\times 25$ . A.M. No. 24634.
- Fig. 31a. *Ponderodictya unicornis* (Van Pelt). Interior of right valve, showing ventral margin and line of contact.  $\times 25$ . A.M. No. 24634.
- Fig. 32. *Ponderodictya pentacornis*, n.sp. Right valve.  $\times 20$ . A.M. No. 24635.
- Fig. 33. *Birdsallella devonica*, n.sp. Left valve.  $\times 30$ . A.M. No. 24639.
- Fig. 34. *Janetina harrietensis*, n.gen., n.sp. Left valve.  $\times 50$ . A.M. No. 24643.
- Fig. 35. *Jenningsina catenulata* (Van Pelt). Left valve.  $\times 45$ . A.M. No. 24644.
- Fig. 36. *Quasillites obliquus*, n.gen., n.sp. Left valve.  $\times 20$ . A.M. No. 24641.
- Fig. 36a. *Quasillites obliquus*, n.gen., n.sp. Dorsal.
- Fig. 37. *Spinovina distributa*, n.gen., n.sp. Left valve.  $\times 30$ . A.M. No. 24640.
- Fig. 38. *Quasillites fordei*, n.sp. Right valve.  $\times 30$ . A.M. No. 24642.

is in the posterior half; greatest convexity nearly central, although the actual greatest thickness is through the ridge crests.

LENGTH.—1.66 mm. HEIGHT.—0.94 mm.

TYPES.—A. M. N. H. Cat. No. 24632.

HEALDIA ROUNDY, 1926

*Healdia arkonensis*, new species

Figure 25

Carapace ovate; dorsal margin arcuate; ventral margin straight with slight central sinuosity of the ventral contact, rounded where it joins the extremities of the valve; end margins rounded, posterior slightly more broadly than the anterior. Overlap of left valve over right is entire, but greatest on anterior half of dorsal, ventral, and on anterior margins; overlap less prominent on posterior dorsal marginal slope and still less on the posterior margin. Posterior swelling, flush with the surface of the valve on its anterior side, rises to a crescentic ridge terminated by short but prominent backward-pointing spines on its dorsal and ventral extremities. A low inconspicuous vertical ridge, with a very slight depression posterior to it is located near the anterior margin of the right valve, about one-fifth of the length from the anterior end. This is absent or only slightly developed on the left valve. Greatest height central; greatest convexity at the posterior swelling.

LENGTH.—0.91 mm. HEIGHT.—0.54 mm.

TYPES.—A. M. N. H. Cat. No. 24633.

Cytherellidae Sars, 1865

CAVELLINA CORYELL, 1928

*Cavellina cuneata*, new species

Figures 27, 27a

Carapace cuneiform; dorsal margin slightly arcuate, nearly straight, and sloping gently from the anterior cardinal angle towards the posterior end which is lower than the anterior; ventral margin concave centrally, becoming gently convex towards extremities, and sloping up from anterior to posterior. Anterior margin broadly rounded with greatest extension below the mid-length; posterior end rounded acuminate at mid-length. Left valve overlaps the right valve on entire margin. Greatest height is about  $\frac{1}{5}$  of the length from the anterior margin, decreasing gently and gradually towards the posterior acumination. Greatest convexity is in posterior  $\frac{1}{3}$  of the valve. The left valve is slightly more convex than the right, but both are very gibbous, so that the convexity is greater than the greatest height of the valves. Convexity decreases abruptly towards posterior margin. Surface of valves smooth.

LENGTH.—0.75 mm. Height.—0.40 mm.

TYPES.—A. M. N. H. Cat. No. 24636.

*Cavellina subplana*, new species

Figures 26, 26a

Carapace subelliptical; dorsal margin slightly arcuate; ventral margin very slightly convex, becoming more rounded towards the rounded extremities; posterior end more highly arcuate than anterior with greatest extension of posterior slightly above the mid-length; greatest extension of anterior end slightly below the mid-

length. Left valve overlaps right on entire margin. Greatest height is located just posterior to the mid-height; greatest convexity in the posterior one-fourth. Convexity is very slight at anterior edge, increasing gradually until about  $1/4$  of the length from the posterior end where the convexity is almost equal to the height. From here the valves slope rather suddenly to the posterior margin. Convexity of the left valve is greater than that of the right. Surface of valves smooth.

LENGTH.—0.67 mm. HEIGHT.—0.45 mm.

TYPES—A. M. N. H. Cat. No. 24637.

#### PONDERODICTYA, NEW GENUS

GENOTYPE.—*Ponderodictya bispinulata* (Stewart), 1927.

Carapace ovate; dorsal margin arcuate; ventral margin nearly straight, slightly convex or slightly concave centrally, with convex anterior and posterior terminations. Anterior end lower than posterior; anterior margin broadly rounded with backward swelling; posterior margin rounded. Surface of valve reticulate except near the margins; smooth surface widest on the ends. Left valve larger than right. Contact rabbetted, of the ridge and groove type.

DISCUSSION.—The genus *Primitiopsis* as figured by Jones in 1887,<sup>1</sup> and in 1888,<sup>2</sup> is a straight-hinged ostracode with an internal shell structure different from that of the new genus here proposed. *Leperditia punctulifera* Hall, 1860,<sup>3</sup> is not figured, and no mention is made of the hinge line. *Primitiopsis punctulifera* (Hall) Jones, 1890,<sup>4</sup> is an ovate, arcuate hinged ostracode which should be removed from the genus *Primitiopsis*, and also placed in another species. *P. punctulifera* (Hall) Jones, 1891,<sup>5</sup> is a straight-hinged ostracode agreeing in general aspect with the genotype *P. planifrons* Jones, 1887. Thus *P. punctulifera* Jones, 1891, is not congeneric with *P. punctulifera* Jones, 1890. *P. unicornis* Van Pelt, 1933, should be removed from the genus *Primitiopsis*.

The specimens of the present study do not show the characteristic overlap of *Cytherella* Jones, 1849, or the internal sculpture of *Cytherellina* Jones and Holl, 1869, so that the species *Cytherella* (?) *bispinulatus* Stewart, 1927, and *Cytherellina punctulifera* (Hall) Warthin, 1934, which are synonymous with *Primitiopsis punctulifera* Jones, 1890, should also be placed in the new genus. The reticulation is so constant and well-defined a character of these forms that it may be regarded, along with the ovate shape, and overlap of the left valve over the right, as a distinctive feature of the genus. For these reasons it is proposed to set up the genus *Ponderodictya* to include the arcuate-hinged, inequivalved,

<sup>1</sup> Jones, T. R., 1887, *Silur. Ostrac.* Gothland, p. 5. Figures copied in Maryland Geol. Sur. Silur., p. 300, Fig. 15, 1925 (Genotype.—*Primitiopsis planifrons* Jones).

<sup>2</sup> Jones, T. R., 1888, *Ann. Mag. Nat. Hist.*, (6) I, p. 406, Pl. xxii, fig. 18 (*Primitiopsis planifrons*).

<sup>3</sup> Hall, J., 1860, Thirteenth Report, Regents Univ. State of N. Y., p. 92.

<sup>4</sup> Jones, T. R., 1890, *Quart. Jour. Geol. Soc. London*, XLVI, p. 9, Pl. II, figs. 7, 12, 13.

<sup>5</sup> Jones, T. R., 1891, *Contrib. Micro-Pal.*, Canada Geol. Sur., III, p. 95, Pl. XI, figs. 10, 11.

reticulate ostracoda, so prevalent in the Hamilton formations of Ontario, Michigan, Ohio, and New York.

***Ponderodictya bispinulata* (Stewart), 1927**

Figures 28, 28a, 29, 30

*Primitiopsis punctulifera* JONES, 1890, Quart. Jour. Geol. Soc. London, XLVI, p. 9, Pl. II, figs. 7, 12, 13 (non Jones, 1891; non *Leperditia punctulifera* Hall, 1860).

*Cytherella* (?) *bispinulatus* STEWART, 1927, Geol. Sur. Ohio Bull., XXXII, p. 60, Pl. v, figs. 18, 19.

*Cytherellina punctulifera* (Jones) WARTHIN, 1934, Contrib. Mus. Paleo., Univ. Mich., IV, No. 12, p. 222, Pl. I, figs. 24, 25.

Carapace ovate; dorsal margin convex; ventral margin straight with central sinuosity in ventral contact; convex at extremities. Posterior margin rounded; anterior margin broadly rounded with backward swing, and lower than posterior. Left valve overlaps right on all margins, with overlap most pronounced ventrally. A ridge near the margin of the right valve fits into a groove in the left. Surface of valve reticulate, with a less ornamented spot just anterior to the center of the valve. Anterior and posterior without reticulations. Two small nodes or spines, the ventral one more prominent, project near the posterior end, from the surface of the convexity, at the crest of the posterior dorsal and posterior ventral slopes. Near the anterior end is a low, non-reticulate, curved ridge, more prominent in the right valve and in some specimens apparently lacking in the left. Greatest height is located about one-third of the length from the posterior end, with convexity greatest near the center of the posterior half of the valve.

LENGTH.—1.33 mm. HEIGHT.—0.88 mm.

PLESIOTYPES.—A. M. N. H. Cat. No. 24638.

NOTE.—The species *Leperditia punctulifera* Hall, 1860 remains as the type of the species *Primitiopsis punctulifera* (Hall) Jones, 1891. Though not described as such, the hinge-line of *L. punctulifera* should be straight, since *Leperditia* is a straight-hinged form, and since Hall described the overlap as being only ventral.

***Ponderodictya unicornis* (Van Pelt), 1933**

Figures 31, 31a

*Primitiopsis unicornis* VAN PELT, 1933, Jour. Paleo., VII, No. 3, p. 326, Pl. XXXIX, figs. 23-28.

Carapace ovately rounded; similar to *Ponderodictya punctulifera*, but with a single posterior ventral spine.

LENGTH.—1.53 mm. HEIGHT.—0.88 mm.

PLESIOTYPES.—A. M. N. H. Cat. No. 24634.

***Ponderodictya pentacornis*, new species**

Figure 32

This species resembles the other members of this genus, but the valves are slightly less convex, and there are three additional nodes, one near the anterior end and one

near the posterior end, just above the ventral margin; and one on the dorsal end of the anterior ridge. Posterior from the anterior ridge, the surface of each valve is depressed.

LENGTH.—1.43 mm. HEIGHT.—0.87 mm.

TYPES.—A. M. N. H. Cat. No. 24635.

**BIRDSALLELLA CORYELL AND BOOTH, 1933**

***Birdsallella devonica*, new species**

Figure 33

Carapace cytherelloid; dorsal margin arcuate, ventral margin with central sinuosity; anterior sharply arcuate; posterior more broadly rounded. The surface near the anterior end descends almost vertically from a low ridge which parallels the anterior margin. Convexity of the valves is slight.

LENGTH.—0.88 mm. HEIGHT.—0.51 mm.

TYPES.—A. M. N. H. Cat. No. 24639.

**SPINOVINA, NEW GENUS**

GENOTYPE.—*Spinovina distributa*, new species.

Carapace cytherelloid; hinge straight, channelled. Right valve overlaps left, with grooved contact in right valve to receive the ridge of the smaller left valve. Surface marked by fine longitudinal ridges. An anterior ventral spine projects forward from the crest of the anterior slope of the convexity. A median spot free from ornamentation is present near the center of the valve.

***Spinovina distributa*, new species**

Figure 37

Carapace ovate; hinge straight, deeply channelled, about one-half as long as the entire shell. Dorsal margin arcuate, ventral margin nearly straight, with curved extremities, more broadly rounded where it joins the posterior margin. Ends rounded, anterior end with distinct backward swing, and higher than posterior end. Right valve is larger than the left, overlapping on entire margin, with overlap much less pronounced dorsally; contact rabbetted. Surface marked by fine longitudinally distributed ridges, bifurcating mostly along the median line, diverging anteriorly. Posterior convexity of the valves is elevated near the margin into a ridge-like swelling at the crest of the steep posterior slope. An anterior ventral spine projects forward from the crest of the steep smooth anterior slope. A less distinctly ornamented spot is present near the center of the shell. Greatest height is slightly anterior of center.

LENGTH.—1.02 mm. HEIGHT.—0.55 mm.

TYPES.—A. M. N. H. Cat. No. 24640.

**Quasillitidae, new family**

Subovate to subrhomboidal ostracodes with straight dorsal margin. Right valve larger than left. Surface of carapace pitted or finely grooved and ridged. A clear muscle spot or pit is usually present near the center of the valve.

Besides the genera described under this family, *Graphiodactylus* Roth should be included here.



## QUASILLITES, NEW GENUS

GENOTYPE.—*Quasillites obliquus*, new species.

Carapace subovate to rhomboidal; hinge line straight. Ventral margin straight to gently convex. Right valve larger than left, with a grooved contact to receive the left valve. Surface of valves is marked by fine longitudinal ridges and grooves, bifurcating along a median line, and diverging slightly anteriorly. A less ornamented median spot is usually discernible. Posterior convexity is generally elevated into a ridge-like surface at the crest of the steep posterior slope. A spine projects forward from the anterior ventral region, at the crest of the anterior slope.

This genus is differentiated from *Graphiodactylus* Roth by the presence of the steep anterior and posterior slopes, the ridge-like elevation of the posterior convexity, the ornamentation, and the anterior ventral spine. It also lacks the anterior dorsal nodes characteristic of the genus *Graphiodactylus*. *Spinovina*, new genus, is differentiated from *Quasillites*, chiefly because of the ovate outline of the carapace and the deeply channelled hinge of *Spinovina*.

*Barychilina rhomboidea* (Jones), 1890, and *Barychilina walcotti* (Jones), 1890, should probably be included in this genus.

*Quasillites obliquus*, new species

Figures 36, 36a

Carapace oblique rhomboidal; hinge line straight, partly covered by the overlap of the right valve in the posterior portion. Cardinal angles obtuse, the posterior larger than the anterior. Ventral margin straight, with broadly curved extremities. Anterior end narrowly rounded in the upper half, with an oblique backward swing in the lower half; posterior end narrowly curved in the lower half, and truncated dorsally. Surface marked by faint longitudinal lines typical of the genus, bifurcating from a median line along the crest of the convexity and diverging anteriorly. A very insignificant posterior ridge is present at the crest of the short steep posterior slope of the surface of the valve; a prominent antero-ventral spine projects forward from the crest of the slope where the convexity of the valve dips steeply to the anterior margin. A less ornamented median area is present near the center of each valve. Right valve overlaps the left on free margins and on part of dorsal margin; right valve is grooved to receive the free margins of the left valve. Greatest convexity is located near the center of the anterior half; height practically uniform throughout; dorsal and ventral margins are parallel.

LENGTH.—1.10 mm. HEIGHT.—0.55 mm.

TYPES.—A. M. N. H. Cat. No. 24641.

*Quasillites fordei*, new species

Figure 38

Carapace suboblong; hinge line straight; ventral margin straight except where it curves to meet the rounded ends of the valves; anterior end almost straight, with backward swing, height about two-thirds as great as the posterior end; anterior cardinal angle slightly obtuse; posterior cardinal angle greater than anterior; great-

est extension of posterior margin is near ventral edge. Surface of valves is covered by fine ridges, an outer set paralleling the outer margins of the valve, and the two inner sets each roughly concentric in the anterior and posterior halves of the valve and converging towards an indefinite transverse cincture which extends from the dorsal to the ventral margin a little posterior to the center of the valve. The fine ridges are connected, rarely, by very thin dissepiment-like cross bars. A poorly defined central spot is present. A small spine projects forward from the antero-ventral region, close to the margin. Surface of valves slopes very gradually to the anterior edge; the posterior surface is slightly more convex than the surface of the anterior half, and the slope to the posterior margin is more abrupt with a slight swelling at the crest of this slope. Greatest height is located about one-fourth of the length from the posterior margin.

LENGTH.—0.68 mm. HEIGHT.—0.40 mm.

TYPES.—A. M. N. H. Cat. No. 24642.

#### JANETINA, NEW GENUS

GENOTYPE.—*Janetina harrietensis*, new species.

Carapace subrhomboidal; hinge line straight. Right valve overlaps left on free margins. A deep round pit is present near the center of the valve. Surface of carapace is ornamented by small pits which are aligned, on the outside slopes of the valve in a roughly concentric arrangement.

#### *Janetina harrietensis*, new species

##### Figure 34

Carapace subrhomboidal; hinge line straight; anterior cardinal angle rounded obtuse; posterior cardinal angle approximately 90 degrees; ventral margin with slight central sinuosity; extremities slightly rounded, but posterior margin is almost straight. Right valve overlaps left on free margins. A shallow sulcus slightly posterior to the center of the valve extends ventrad from the dorsal margin to a deep round pit just above the mid-length. The convexity of the valve rises slightly on the anterior and ventral edges of the pit. Surface of valve is covered by small pits, which give place, on the slopes of the valve near the margins, to a roughly concentric alignment. Greatest height is through the posterior cardinal angle. Convexity is very slight in posterior, increasing gradually towards the anterior until it is greatest about one-fourth of the length from the anterior end. From here the surface slopes steeply to the margin. Greatest convexity is equal to about two-thirds of the greatest height.

LENGTH.—0.75 mm. HEIGHT.—0.45 mm.

TYPES.—A. M. N. H. Cat. No. 24643.

#### JENNINGSINA, NEW GENUS

GENOTYPE.—*Jenningsina catenulata* (Van Pelt), 1933.

Carapace subreniform; hinge line straight. Surface of valve covered with fine ridges diverging from a median line. These ridges are connected by cross bars at intervals slightly larger than the space between two ridges, thus producing in effect rows of elongate reticulations. In the center of the valve is a small circular pit. Right valve overlaps the left on free margins.

*Jenningsina catenulata* (Van Pelt), 1933

Figure 35

*Graphiodactylus catenulatus* VAN PELT, 1933, Jour. Paleo., VII, No. 3, p. 333, Pl. xxxix, figs. 31, 32.

Carapace subreniform; hinge line straight, about two-thirds as long as the carapace; cardinal angles not sharply obtuse, the posterior angle greater than the anterior. Ventral margin gently concave, rounding into the curved end margins; anterior end truncated and flattened; posterior end curved with high arc, with greatest extension just below the median line. Surface of valve covered with fine ridges, diverging from a median line at about 30 degrees in the ventral half of the valve and about 45 degrees in the dorsal half. These ridges are connected by cross bars at regular intervals slightly larger than the space between two ridges, thus producing a row of elongate reticulations. Small circular pit in center of valve. Towards the anterior one-fourth of the surface the ridges tend to become parallel. Greatest height is located about one-fourth the length from the posterior margin; greatest convexity just inside the anterior margin; the surface of the valve rises gradually from the posterior to the anterior and drops abruptly to the anterior contact. Right valve overlaps left on free margins.

LENGTH.—0.55 mm. HEIGHT.—0.32 mm.

PLESIOTYPES.—A. M. N. H. Cat. No. 24644.

A NEW LIZARD OF THE GENUS *SCELOPORUS* FROM  
SOUTHERN MEXICO

BY HOBART M. SMITH

An examination of the *Sceloporus* material in The American Museum of Natural History, preparatory to a proposed study of the entire genus, has revealed four specimens<sup>1</sup> of an undescribed species, which may be known as *Sceloporus pictus*, new species.

*Sceloporus pictus*, new species

HOLOTYPE.—A. M. N. H. No. 18744, male, collected near Santa Catarina, Puebla, on July 27, 1920, by Paul D. R. Rütthling.

PARATYPES.—A. M. N. H. No. 18745, 18748–9, collected with the type.

DIAGNOSIS.—A *Sceloporus* of small size (maximum snout-vent measurement approximately 55 mm.); dorsal scales 45 to 56 from occiput to base of tail; lateral scales in oblique rows converging dorsally; scales around middle of body 47 to 52; nasal separated from rostral; one or two canthals; auricular lobules three to five, the upper lobule usually the shortest; femoral pores 15 to 18 on each side, the two series separated medially; caudal scales about twice as large as median dorsal scales on body; subcaudals keeled except near base of tail, more strongly keeled in females than in males; preanal scales smooth in females; ventral abdominal scales about half as large as median dorsal scales; dorsal scales on tibia subequal in size to median dorsal scales on body. General dorsal color gray-olive or brown-olive; a broken clove-brown band on each side of the body, bordered above and below by a narrow light line; limbs narrowly banded; a dark spot in front of shoulder; males with dark blue areas on sides of belly, black-bordered medially.

DESCRIPTION OF HOLOTYPE.—Head scales smooth, weakly pitted; interparietal large, longer than broad, broader posteriorly than anteriorly, its posterior edge rounded; a single parietal on each side, one-fourth or one-fifth size of interparietal; a moderately large scale posterior to parietal which might be considered a secondary parietal, but which appears to be two nuchal scales fused together; a pair of very small, rectangular frontoparietals, separated medially by broad contact of the frontal and interparietal; frontal transversely divided, the posterior section two-thirds as large as anterior section; prefrontals moderate in size, separated medially by contact of frontal and median frontonasal; latter scale somewhat larger than either lateral frontonasal; a pair of narrow scales in front of median frontonasals, preceded by another similar pair of scales; five enlarged supraoculars on each side, the median scale divided on one side; two anterior supraoculars abnormally in

<sup>1</sup> I wish to express my appreciation to Dr. G. K. Noble for his kind permission to examine and describe these specimens, and to Mr. C. F. Kauffeld for numerous courtesies facilitating the study of these and other specimens.

contact with median head scales on each side; other supraoculars separated from median head scales by a row of small scales; one complete and another incomplete row of scales separating supraoculars from superciliaries; six superciliaries on each side, normal; one canthal on each side; subnasal present, larger than loreal; preocular not divided; subocular long, single, followed posteriorly around margin of orbit by two keeled postoculars; two incomplete rows of lorilabials, reduced to one row below subocular; one row of lorilabials continuous around end of snout; three and one-half or four supralabials and four infralabials to a point below middle of eye.

Mental pentagonal, with a labial border about half that of rostral; outer row of labiomentals separated from mental by narrow contact of first postmental and first infralabial; three pairs of well-differentiated postmentals, followed by several scales not well differentiated from adjoining gular scales; first pair of postmentals in contact medially; most of gular scales with a single apical notch; gular scales all nearly equal in size, somewhat smaller than scales on breast, smallest below ear and between postmentals.

Auricular lobules three-four, the upper scale on one side considerably larger than the others (apparently injured early in life on other side); about six scales between auricular lobules and postoculars; temporal scales keeled, immucronate, larger than scales between ear and lateral nuchal fold, smaller than largest auricular lobule; scales between ear and lateral nuchal fold keeled, mucronate; a series of keeled, mucronate scales passing from near upper edge of nuchal fold to below middle of ear.

Dorsal scales not reduced in size on nape, weakly keeled, weakly mucronate, their free edges nearly straight, not rounded; lateral scales about one-third smaller than dorsals, not abruptly differentiated from them, more strongly keeled and mucronate than dorsals; all ventral scales except some on midventral line with a single apical notch; scales in axilla and groin imbricated, notched; scales on chest slightly larger than midventral scales; preanal scales somewhat smaller than lateral abdominal scales, subequal in size to smallest midventral scales; dorsal scales on rump somewhat reduced; dorsal caudal scales at least twice as large as scales on rump.

Dorsal scales of upper foreleg keeled, mucronate, subequal in size to dorsal scales on body, slightly larger than largest dorsals on lower foreleg; scales on ventral surface of upper foreleg very small, notched, smooth, those of lower foreleg somewhat larger, weakly keeled, weakly mucronate; lamellar formula for fingers 8-13-18-18-12 (8-12-17-17-11).

Dorsal scales of shank subequal in size to median dorsals on body, dorsal scales of thigh slightly smaller; scales on anterodorsal surface of shank near tibio-metatarsal joint greatly reduced in size; ventral scales of shank notched, smooth, smaller than dorsal scales of same member; scales on anterior surface of thigh smooth, notched, somewhat smaller than dorsal scales of same member, rather abruptly decreasing in size on ventral surface near series of femoral pores; scales preceding femoral pore series subequal in size to preanal scales; median scales on posterior surface of thigh keeled, mucronate, subequal in size to scales in preanal region, decreasing in size toward series of femoral pores; no postfemoral dermal pocket; enlarged postanals present, broader than long, separated narrowly by two small scales; lamellar formula for toes 8-13-18-19-14 (8-11-16-20-14).

COLOR.—Dorsal surface olive-gray or brown-gray; a narrow light line from upper posterior margin of orbit along sides of body to rump, its medial edge not

well defined, the lateral edge distinct; area between these lines without marks; below the lateral light line is a broad, broken, clove-brown band, bordered below by a narrow light band from axilla to groin; below this are irregular, scattered spots of clove-brown, absent toward ventral surface; a narrow white line through ear near upper edge, from upper labial region to upper margin of insertion of foreleg, bordered below on neck by a broad clove-brown band passing through lateral nuchal fold and becoming intense black on shoulder; limbs with narrow, clove-brown bands; posterior surface of thigh irregularly reticulated with clove-brown.

Males with throat white, reticulated or with broad, convergent lines of pale blue; chest, middle of belly and ventral surfaces of limbs whitish, with a bluish suffusion; sides of abdomen cyanine blue, bordered medially by a narrow line of black; groin black; base of tail and a narrow line down the middle of the ventral surface of the tail, whitish, usually with a bluish suffusion.

Females apparently uniform white or cream below. The throat may be reticulated with pale blue.

VARIATION.—The three paratypes show the following variation in scalation of the head. Frontoparietals divided in none; frontal touches interparietal in all; frontal normally divided in all; one complete and another incomplete row of scales between supraoculars and superciliaries; from one to five of the supraoculars may be divided, the outer sections always smaller than the inner; supraoculars separated from median head scales; prefrontals in contact medially in two, and separated medially by an azygous scale in one; nasal separated from rostral in all; canthals 2-2 in one, 1-1 in two; lorilabials in two incomplete rows, reduced to one row below subocular; outer row of labiomentals separated from mental; inner row of labiomentals terminating anteriorly between the anterior part of the third infralabial and the posterior part of the second; scales of anterior pair of postmentals in contact medially; auricular lobules three to five, the upper largest in all.

#### MEASUREMENTS (IN MM.) AND SCALE COUNTS OF *Sceloporus pictus*

A. M. N. H. Nos.	18745	18748	18744	18749
Snout to vent	47.5	52.0	52.7	54.0
Tail	...	71.0	...	...
Snout to occiput	9.5	9.5	10.8	...
Snout to ear	11.4	11.2	12.8	13.0
Hind leg	32.6	32.7	...	34.9
Tibia	8.9	10.0	10.0	10.0
4th toe	13.1	13.4	13.3	13.7
5th toe	5.7	6.0	6.3	6.3
Lamellae 4th toe	21-21	21-21	19-20	19-20
Femoral pores	18-18	?-?	15-16	17-18
Dorsals	50	56	52	50
Ventrals	53	56	57	53
Scales around body	47	51	52	51
Scales to head length	9.7	9.6	12.0	...
Ratio hind leg to snout-vent	68.6	62.8	...	64.6
Ratio 4th toe to snout-vent	27.5	25.7	25.2	25.3
Sex	♀	♀	♂	♂

The scales on the nape of the neck are reduced in size in one specimen; the subcaudal scales are strongly keeled in the females except immediately behind the anus; other body and limb scales are approximately as in the type.

RELATIONSHIPS.—The only species of *Sceloporus* to which *pictus* is closely related is *megalepidurus* Smith, from which it differs by possessing fewer scales from occiput to base of tail (45 to 56 *pictus*, 56 to 61 in *megalepidurus*); femoral pores average more numerous (15 to 18 in *pictus*, 15 to 17 in *megalepidurus*); scales between series of femoral pores average fewer (three or four in *pictus*, four to seven in *megalepidurus*); basal subcaudals more strongly keeled (strongly keeled in females of *pictus*, smooth except near distal end of tail in *megalepidurus*); dorsal caudal scales proportionately larger; dorsal scales of shank smaller (subequal in size to median dorsal scales in *pictus*, larger in *megalepidurus*); no markings on the back (a double series of dark spots down back in *megalepidurus*); males with distinct blue areas on sides of belly (uniformly whitish or with a general suffusion of pale blue in *megalepidurus*).

# AMERICAN MUSEUM NOVITATES

Number 893

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

Dec. 16, 1936

## STUDIES OF PERUVIAN BIRDS. NO. XXIII<sup>1</sup>

### NOTES ON *DOLIORNIS*, *PIPREOLA*, *ATTILA*, *LANIOCERA*, *RHYTIPTERNA*, AND *LIPAUGUS*

BY JOHN T. ZIMMER

The names of colors in the following paper are capitalized when direct comparison has been made with Ridgway's 'Color Standards and Color Nomenclature.'

#### *Doliornis sclateri* Taczanowski

*Doliornis sclateri* TACZANOWSKI, 1874, P. Z. S. London, p. 136, Pl. xx—Maraynioc, Perú; ♂; British Mus.

This fine species is represented in the American Museum collections by two males and one female from the type locality. Since the female plumage is undescribed, the following brief diagnosis may prove serviceable.

Whole top of head with exposed portions gray like the sides of the head but with dusky shaft-lines; concealed rufous area somewhat paler than in the male plumage; lores gray with only a small blackish stripe through the middle; back and upper tail-coverts very little lighter than in the male. Throat much as in the male but with a faint brownish tinge; breast warm dark brown as in the male but the belly much paler and with broader buffy tips than in the other sex; under tail-coverts somewhat paler russet than in the male; size slightly smaller. Wing, 95.5 mm.; tail, 82; (bill with broken tip); tarsus, 27.

The type is the only other known specimen of this form.

#### *Pipreola riefferii* chachapoyas (Hellmayr)

*Euchlornis viridis chachapoyas* HELLMAYR, 1915 (July 25), Verh. Orn. Ges. Bayern, XII (3), p. 206—Chachapoyas, Perú; ♂; Munich Mus.

Fourteen birds from the Chachapoyas region are topotypical and vary but little among themselves. All the males have the throat and chest quite dark though not so blackish as in average *occidentalis*. One male from Chachapoyas is rather more heavily marked on the lower

<sup>1</sup> Earlier papers in this series comprise American Museum Novitates, Nos. 500, 509, 523, 524, 538, 545, 558, 584, 646, 647, 668, 703, 728, 753, 756, 757, 785, 819, 860, 861, 862, and 889.



under parts than the others and it also has the darkest throat of all. Several specimens have the lower belly immaculate yellow, but most of the examples have at least a trace of dusky centers on the feathers of this area. The cap is steel blue, sharply defined from the back and with the subterminal portions of the feathers dead blackish, but one or two specimens show a slight greenish tinge posteriorly, coupled with a little dullness of color on the whole cap, which may be due to recent arrival at maturity. These points are significant in view of the fact that east-Ecuadorian birds differ from the Chachapoyas examples by characters of this nature, as described below.

Records of *chachapoyas* are from Nuevo Loreto, Tamiapampa, and Huambo.

The Nuevo Loreto record, based on a pair of birds originally assigned by Ménégau to "*P. similis*" (= *P. intermedia*), is important since *intermedia* also occurs on the Río Mixiollo only a short distance above Nuevo Loreto, at Compan. This proximity of range, although the two localities are at different elevations, makes it advisable to maintain the specific integrities of the *riefferii* and *intermedia* groups (following Hellmayr), since both are Subtropical Zone inhabitants.

#### *Pipreola riefferii confusa*, new subspecies

TYPE from upper Sumaco, eastern Ecuador. No. 183,721, American Museum of Natural History. Adult male collected February 2, 1924, by Carlos Olalla and sons.

DIAGNOSIS.—Similar to *P. r. chachapoyas* of the Chachapoyas region of northern Perú, but whole head and upper breast more definitely greenish; lower breast and belly even more strongly marked, with the dark, lanceolate, subterminal spots deeper green and more sharply defined and averaging broader; definition between the colors of occiput and mantle less pronounced.

Compared with *P. r. riefferii* of eastern Colombia, the head and throat are somewhat darker and less greenish on average, and the lower under parts are decidedly more heavily marked. The bill is smaller, more as in *chachapoyas*. Compared with *occidentalis* of western Ecuador and western Colombia, the head and throat are greener, the lower under parts more heavily marked, and the bill is smaller.

RANGE.—Eastern Ecuador, ranging south to Perú north of the middle Marañón; possibly reappears in the Antioquia region of Colombia.

DESCRIPTION OF TYPE.—Top of head with glossy tips approaching steel blue on the forehead but with a greenish tinge more posteriorly; subterminal portions of crown and occiput Dusky Green; hind neck with glossy tips greener and gradually reduced in prominence, passing with little interruption into the color of the mantle; back bright Spinach Green. Lores somewhat blackish; rest of sides of head Dull Blackish Green; sides of neck dark green with Lemon Yellow tips which form a nearly complete collar; chin, throat, and upper part of breast bright Elm Green, darker anteriorly and merging laterally into the color of the sides of the head;

the lower feathers of this area are tipped with Lemon Yellow; lower part of breast with these yellow tips broadened and carried around to the terminal part of the lateral margins, and with the dark green subterminal portions withdrawn centrally to form a broad sagittate central mark but with a slender yellowish shaft line or spot developed in the center; belly similarly marked but (medially) with the pattern somewhat smaller though not less distinct; sides of the breast clear, dark green with bright yellow tips on the uppermost feathers (continuous with the collar and breast band) but with only slight indication of yellow tips on the remainder; flanks dark green with poorly defined yellowish tips; under tail-coverts like the sides of the belly with yellow tips and dark, sagittate centers. Remiges blackish with dull whitish inner margins and bright green outer margins (except on outermost primary); the tertials and the inner secondaries have the green margin broadened to reach the shaft near the tip which is further distinguished by a yellowish white terminal band; upper wing-coverts with exposed portions green; greater series with nearly obsolete traces of yellowish tips; under wing-coverts and axillars yellowish with dusky sub-terminal areas, darkest at the carpal margin. Tail with median rectrices and outer webs of remaining feathers green like the back; remaining areas dull blackish. Bill (in dried skin) deep yellow; feet deep yellow; claws dark brown. Wing, 90.25 mm; tail, 73; exposed culmen, 12; culmen from base, 17.25; tarsus, 23.

REMARKS.—Female with top of head green like the back; sides of head, throat, and upper breast a little paler; chin, lores, and circumocular ring variably yellowish or green like the surrounding areas; remainder of plumage like that of the male.

There is some variation among the males without matching any of the specimens of *chachapoyas*. A topotype and a specimen from Baeza have the top of the head rather blacker than in the others, but there is still a tinge of green on it and the breast is strongly greenish; the topotype is the most heavily marked of all on the lower under parts. Similarly, a female topotype is the most heavily marked example of that sex.

A male from Santa Elena, Antioquia, Colombia, presents a curious situation. This bird agrees well with the east-Ecuadorian specimens, with very heavily marked under parts, green throat, and strongly greenish nape, and in size is small, also more in accord with *confusa* than with either *riefferii* or *occidentalis*. One female from the same locality is heavily marked, but two others have rather more yellow on the belly, suggesting typical *riefferii*. An adult male from El Eden, south of Santa Elena on the same cordillera, unquestionably is *riefferii*, with very broadly extended immaculate yellow on the belly.

No specimen from the Bogotá region resembles the Santa Elena male very closely. Four males and one female of typical "Bogotá make" are slightly more heavily marked below than the average, but they also have the top of the head and the anterior under parts the greenest of all the birds at hand. The other Bogotá specimens, includ-

ing Anolaima, Subia, El Roble, and Fusugasugá, as well as "Bogotá," all have more yellow on the belly with strongly green chests, like the El Eden bird, although the top of the head is sometimes (though rarely) blackish. It thus seems impossible to refer the Santa Elena specimen to *riefferii*.

A stronger probability is that it is an unusual example of *occidentalis*. There is some variation in this western subspecies, although I have seen no example which combines the heavy ventral spotting and the prominently greenish head, although one or the other occurs singly in certain examples. The two yellow-bellied females and the zonal connection of Santa Elena and El Eden argue against this solution. More material from the Antioquia region is very desirable to settle the status of the resident form.

In any case, I believe the east-Ecuadorian birds to be, as a unit, quite recognizable. Hellmayr at one time, when describing *chachapoyas*, placed them with the Chachapoyas form but later consolidated them with *riefferii*. They cannot well be placed with either since they go beyond *chachapoyas* in certain respects while approaching *riefferii* in others.

A Chaupe (Perú) bird is assigned to *confusa* with slight misgivings. The specimen is not in perfect plumage and appears to be somewhat intermediate, as the locality is intermediate. In general it is closer to the Ecuadorian series and is placed there until further material may be available to confirm or alter this disposition.

#### SPECIMENS EXAMINED

*P. r. riefferii*.—COLOMBIA: "Bogotá," 8 ♂, 4 ♀; Choachi, 1 ♂; Anolaima, 1 ♂; Subia, 2 ♂, 1 ♀; Fusugasugá, 1 ♂; El Roble, 2 ♀.

*P. r. melanolaema*.—VENEZUELA: Culata, 3 ♂, 2 ♀; Valle, 4 ♂, 2 ♀; El Hechisera, 1 ♂; Mérida, 5 ♂, 2 ♀; Escorial, 2 ♂, 1 ♀; Mucuchies, 1 ♂; Galipan, 2 ♂.

*P. r.* (subsp.?).—COLOMBIA: Santa Elena, 1 ♂, 3 ♀.

*P. r. occidentalis*.—COLOMBIA: San Antonio, 7 ♂ (incl. type), 4 ♀; "Cauca," 1 ♂; Las Cruces, 1 ♂, 1 ♀; Cocal, 1 ♂; Cerro Munchique, 1 ♂, 3 ♀. ECUADOR: Guala, 1 ♂, 1 ♀; Mindo, 1 ♂; Verdecocha, 1 (?); Salvias, 1 ♂. (No locality), 1 ♂.

*P. r. confusa*.—ECUADOR: Upper Sumaco, 2 ♂ (incl. type), 1 ♀; above Baeza, 1 ♂, 1 ♀; Macas region, 1 ♀; Sabanilla, 1 ♀. PERÚ: Chaupe, 1 ♂.

*P. r. chachapoyas*.—PERÚ: Chachapoyas, 3 ♂; San Pedro, 4 ♂, 1 ♀; La Leija, 3 ♂, 3 ♀.

#### *Pipreola intermedia intermedia* Taczanowski

*Pipreola viridis intermedia* TACZANOWSKI, 1884, 'Orn. Pér.' II, p. 376—Maraynioc, Perú; ♂; Warsaw Mus.

Rumicruz, 1 ♂, 1 ♀; Chilpes, 2 ♀.

A male from Compan, east of Tayabamba, first recorded by Ménégau, has been found by Hellmayr to belong to this subspecies. Aside from this record, the form is known only from the Junín region.

Records are from Maraynioc, Culumachay, Pumamarca, and Compan.

*Pipreola intermedia signata* (Hellmayr)

*A(mpelis) viridis* D'ORBIGNY AND LAFRESNAYE (nec THUNBERG, 1823), 1837, Mag. Zool., VII, cl. 2, 'Syn. Av.,' p. 40—Yungas in Bolivia; ♀; Paris Mus.

*Euchloris riefferii signata* HELLMAYR, 1917 (Sept. 20), Verh. Orn. Ges. Bay., XIII (2), p. 199—new name for *Ampelis viridis* D'ORBIGNY AND LAFRESNAYE.

Below Limbani, 2 ♂, 1 ♀.

I can find no distinctions between the Peruvian birds and six examples from Bolivia except that one of the Limbani males shows a tendency toward typical *intermedia* by having the yellow of the lower under parts less broadly developed; the second Limbani male is as broadly marked as the Bolivian birds, although the black lunules on the sides of the belly are weaker. Judging by the variation among the females, these differences probably are purely individual.

Records are from Huaisampilla.

SPECIMENS EXAMINED

*P. i. intermedia*.—PERÚ: Rumicruz, 1 ♂, 1 ♀; Chilpes, 2 ♀.

*P. i. signata*.—PERÚ: "Camp 1, below Limbani," 2 ♂, 1 ♀. BOLIVIA: Inca-chaca, 1 ♂, 2 ♀; Cocapata, 1 ♂; Sandillani, 1 ♀; Yungas, Cochabamba, 1 ♀.

*Attila cinnamomeus* (Gmelin)

*Muscicapa cinnamomea* GMELIN, 1789, 'Syst. Nat.,' I (2), p. 937—based on "Cinnamon Flycatcher," LATHAM, Gen. Synop. Birds, II (1), p. 354; Cayenne; type formerly in Leverian Mus., now lost.

*Muscicapa thamnophiloides* SPix, 1825, 'Av. Bras.,' II, p. 19, Pl. xxxvi, fig. 2—"in locis sylvaticis fl. Amazonum"; Munich Mus.

*Tyrannus rutilus* LESSON, 1844, Echo du Monde Sav., XI, 2 sem., No. 11, p. 254—Cayenne.

*Lanius unirufus* (CUVIER MS.) PUCHERAN, 1855, Arch. Mus. Hist. Nat. Paris, VII, p. 332—Cayenne; Paris Mus.

*Thamnophilus strenuus* SCLATER, 1862, 'Cat. Coll. Amer. Birds,' p. 173—Cayenne; British Mus.

Puerto Indiana, 1 ♂, 1 ♀; Sarayacu, 2 ♂, 1 ♀.

No taxonomic distinctions exist in the one hundred and nine specimens at hand from various localities.

One of the males from Sarayacu has an unusually long tail—91.5 mm.

as against the ordinary range of 76–84.5 with which the other Peruvian birds are in agreement. The other measurements of this specimen are normal. The color is somewhat richer than that of the average specimen, being farthest removed from that of *torridus*.

Records are from Lagunas, Elvira, and Samiria.

I am unable to agree with the specific association of *cinnamomeus* and *torridus*, although there is some resemblance between them in various particulars. Two factors remain notably distinct and show no signs of any approach toward each other. In the first place the bill of *torridus* is flattened toward the base, with the culmen slightly concave in outline in advance of the nostrils. The bill of *cinnamomeus* is more typically cotingine, being slightly swollen in all outlines. Examples of *cinnamomeus* with especially long bills, approaching in size the bills of *torridus*, still have the typical *cinnamomeus* outline without any tendency toward the tyrannine appearance of the western species.

Both species have the tarso-metatarsus modified holaspidean on the upper portion, changing to pycnaspidean on the lower part, but the acrotarsium is markedly different in the two groups. In *torridus*, the outer aspect shows the scutellae withdrawn toward the anterior margin, leaving a relatively broad, unscutellated space between them and the plantar scales. In *cinnamomeus*, the acrotarsal plates are much broader, meeting the plantar scales nearer the line of the posterior margin, and often at least one of the scales is slightly curved around this margin in a trend toward an exaspidean formation. This characteristic is a rather fundamental one which is likely to be of more than subspecific import, but it is probably not of generic value in the present instance since most of the other species of the genus are intermediate in this respect, though *citriniventris* is very like *torridus*.

On the other hand, *phoenicurus* (which resembles *cinnamomeus* in general coloration except for the gray cap) goes even farther and has the tarso-metatarsus as definitely exaspidean as some genera of the Tyrannidae, although the basal phalanges of the toes are slightly more coherent. The bill, furthermore, is still shorter, as are the feet, and the wing formula is noticeably different from that of all the remaining species of *Attila*. It may well be separated, therefore, as a new genus to which *Attila cinnamomeus* shows the nearest approach. It may be known as follows.

#### PSEUDATILA, NEW GENUS

Similar to *Attila* but with tarsus shorter, exaspidean; wing more pointed; 7th, 8th, and 9th primaries longest; 10th subequal to the 5th (instead of 6th, 7th,

and 8th longest and with 10th shorter than the 4th, sometimes shorter than the 1st); bill relatively shorter and with more swollen outlines.

Bill about as long as head or shorter, moderately broad and swollen, its depth at nostrils more than half the distance from nostrils to tip of maxilla and about equal to its width at the same point; culmen slightly convex, strongly and abruptly decurved terminally, with tip of maxilla strongly uncinatc; gonys strongly convex, about equal to mandibular rami; basal width of intraramal space about equal to its length; maxillary tomium straight, distinctly notched subterminally; mandibular tomium similar (without decurved tip). Nostrils partially hidden by overhanging latero-frontal bristles and plumules, rather large, broadly oval; rictal bristles strongly developed; the bristly points of the loreal, antorse latero-frontal, and interior intraramal plumules only slightly less so. Wing moderately short and rounded, the longest primaries exceeding the secondaries by about the length of the exposed culmen; 7th, 8th, and 9th primaries longest, 10th subequal to the 5th. Tail about as long as the length of wing to the end of the secondaries, slightly rounded or double rounded; rectrices rounded or slightly pointed. Tarsus exaspidean, decidedly longer than exposed culmen but shorter than culmen from base, one-fifth as long as wing; middle toe with claw only a little shorter than the tarsus, adherent for most of its length to the outer toe and only at the base to the inner toe; outer toe, without claw, reaching somewhat beyond the middle of the subterminal phalanx of the middle toe; inner toe shorter than outer toe; hallux about as long as inner toe, somewhat stouter, its basal pad slightly expanded and flattened.

TYPE.—*Attila phoenicurus* Pelzel.

One specimen from Paraná has the planta-tarsi holaspidean for a little more than half the length; but the lower anterior scales show the exaspidean formation; six examples have the posterior scalation confined to the uppermost portion (as in various Tyrannidae). Two examples have the tenth primary shorter than the fifth but longer than the fourth; one has it just longer than the fourth; in none is it shorter than the fourth. In all the specimens at hand the ninth primary is among the three longest; in one specimen it is the longest of these three. In the various members of *Attila*, however, the ninth primary is shorter than the fifth or sixth and the tenth primary is shorter than the first, second, third, or fourth; in one example of *citriniventris* it is a little longer than the fourth; in three other examples of the same form it is the shortest of all.

The tarsal characteristics and wing-formula of *Pseudattila* are sufficient to separate it from *Casiornis* with which the shape of the bill suggests relationship. In *Casiornis*, wing and tarsus are much as in *Attila*.

In wing, tarsus, and bill there is considerable similarity to *Laniocera*, but the toes are so greatly united at the base in *Laniocera* as to have caused that genus to be placed in the *Pipridae* by some authors, whereas

in *Pseudattila* the toes are decidedly less united than in many Cotingidae.

Whether this genus belongs in the Tyrannidae or in the Cotingidae must await study of internal features. The genus *Attila* is in like predicament.

#### SPECIMENS EXAMINED

*A. cinnamomeus*.—FRENCH GUIANA: 5. DUTCH GUIANA: 8. BRITISH GUIANA: 2. BRAZIL: 77. VENEZUELA: 5. ECUADOR: 3. PERÚ: 5.

*A. torridus*.—ECUADOR: 12.

*A. bolivianus* (sensu lato).—BOLIVIA: 6. BRAZIL: 13. PERÚ: 1.

*A. spadiceus*.—MEXICO to BOLIVIA: 146.

*A. rufus*.—BRAZIL: 17.

*A. citriniventris*.—VENEZUELA: 2. BRAZIL: 2.

*P. phoenicurus*.—BRAZIL: 7.

#### *Laniocera hypopyrra* (Vieillot)

*Ampelis hypopyrra* VIEILLOT, 1817, 'Nouv. Dict. Hist. Nat.,' nouv. éd., VIII, p. 164—"la Guyane" = Cayenne.

*Muscicapa sibilatrix* WIND, 1831, 'Beitr. Naturg. Bras.,' III (2), p. 810—forest road of Capitão Filisberto, near Ilhéos, southern Bahia; cotypes in American Mus. Nat. Hist.

*Laniocera sanguinaria* LESSON, 1840, Rev. Zool., III, p. 353—hab. ign.

*Lipangus lateralis* GRAY AND MITCHELL, 1847, 'Gen. Birds,' I, Pl. LX.

Seventy specimens have been examined without finding any characters which might serve to distinguish any local subspecies. Of the cotypes of *sibilatrix*, one is larger than any other specimen at hand, but the other is no different from skins from other localities.

Twenty-one skins of both sexes and from various parts of the range show the orange-rufous patch on the belly, with the feathers tipped with black, such as has been noted by many observers in the past. In every specimen so marked there is evidence of immaturity and only two additional specimens show vestiges of immaturity without the presence of this abdominal patch. Consequently it is logical to conclude that this feature is not a dimorphic attribute but rather a sign of immaturity.

Accompanying the rufous and black patch on the belly is a modification in the color of the inner remiges and the upper wing-coverts. In the adults these are tipped (rarely only subterminally marked) with a dull cinnamon-buff spot or diamond-shaped mark in a dark brownish-gray field. In the immature birds, the light spot is much brighter and is placed in a sooty black field which includes a strong terminal black bar. Specimens are at hand which are molting from the immature stage to the adult one, showing the difference and the transition very

clearly. The under tail-coverts are like the center of the belly, rufous with black tips, and there are specimens showing similar feathers on the flanks, upper tail-coverts, breast, interscapulars, and superciliary region (this last without black tips), all of fluffy texture and obviously juvenal. I have no specimen in full juvenal plumage, but from this evidence it appears that the juvenal dress is likely to be composed entirely of such rufous and black feathers except, perhaps, for the remiges and rectrices.

The greatest variation in the size of the spots on the wings is shown in the young birds in hand. One has the rufous marks almost obsolete while another from the same locality has them enormous. Adults are somewhat variable in this respect but to a lesser degree. The tip of the pointed rectrices of the young birds is sometimes finely black but usually is entirely rufous. The upper tail-coverts, even when there is no fluffy juvenal feather in evidence, usually has the olive-gray color enlivened by a faint indication of terminal black and subterminal rufous. This is occasionally seen in more fully adult specimens.

There is great variation in the extent of the rufous patch on the belly, aside from the occurrence of similarly colored feathers elsewhere in the plumage. Some examples have but a few remaining feathers of this sort and one or two have lost all of them though they still retain several of the characteristic plumes among the upper wing-coverts.

All of these young birds have the light shoulder-patch relatively dull, sometimes obsolete, and when developed it shows definite bars of olivaceous gray alternating with yellow or rufous as in the adult females. Adult males have this patch relatively clear and more extensive, also either yellow or rufescent.

The brightly colored tuft on the upper flanks likewise varies in color, being either rufescent or yellow, although the immature specimens sometimes show a mixture even on single feathers. In the adult males the tuft is relatively clear, with no more than slight dusky barring on some of the lower feathers. The adult females have the bars much more developed and the immature examples of both sexes agree with them in this respect.

The only immature birds with evidences of molt of the remiges and rectrices are specimens which have lost all of the brightly colored feathers on the belly and most of the black-tipped upper wing-coverts. Two such examples show part of the body plumage also in molt, but there is little difference, except in freshness of appearance, between the old and new feathers involved in this process. This would make it appear that the postjuvenal molt is but partial and the first "winter" plumage



of but short duration, being followed by a complete (prenuptial ?) molt into fully adult dress. Specimens in complete juvenal plumage would be interesting for comparative study.

Peruvian records are from Chayavitas, Santa Cruz, and "Peruvian Amazon."

#### SPECIMENS EXAMINED

*L. hypopyrra*.—FRENCH GUIANA: Ipousin, 1 ♂. DUTCH GUIANA: "interior," 3 (?). BRITISH GUIANA: Tumatumari, 1 ♂; Bartica Grove, 2 ♀. VENEZUELA: Suapuré, 1 ♂, 2 ♀; Nicaré, 1 ♂; La Prisión, 3 ♂, 1 ♀; Nericagua, 1 ♂; Caura, 2 ♂, 1 "♀" (= ♂); Río Cassiquiare, El Merey, 2 ♂; Mt. Duida, 3 ♂, 1 ♀. BRAZIL: Rio Negro, Santa Maria, 1 ♂; Tahuapunto, 2 ♂; Yavanari, 1 ♂; Tatú, 2 ♂, 1 ♀; Mt. Curycuriari, 1 ♂; Obidos, 2 ♂; Faro, 3 ♂; Prata, Pará, 1 ♂; Rio Tocantins, Baião, 1 ♂; Mocajuba, 1 ♂, 1 ♀; Rio Tapajoz, Limoal, 2 ♂; Tauary, 1 "♂"; Igarapé Amorin, 4 ♂; Igarapé Brabo, 2 ♂; Aramanay, 1 ♀; Caxiricatuba, 1 ♂; Boim, 1 ♂; Rio Madeira, Igarapé Auará, 1 ♂; Calamá, 1 ♀; Rosarinho, 2 ♂; Teffé, 1 ♂, 1 ♀; "Brazil" = Bahia (cotypes of *Muscicapa sibilatrix*), 1 ♂, 1 "♀" (= ♂). PERÚ: Río Ucayali, Santa Rosa, 3 ♀; mouth of Río Urubamba, 1 ♂, 1 ♀; Chuchurras, 1 ♂; Puerto Bermúdez, 1 ♂<sup>1</sup>. ECUADOR: (no other locality), 1 ♀.

#### *Rhytipterna simplex frederici* (Bangs and Penard)

*Lipaugus simplex frederici* BANGS AND PENARD, 1918 (April), Bull. Mus. Comp. Zool., LXII, p. 71—vicinity of Paramaribo, Surinam; ♂; Mus. Comp. Zool.

Sixty-five specimens from British and Dutch Guiana, southern Venezuela, and Brazil, north of the Amazon, are relatively uniform in their grayish coloration, that forms the best character for the distinction of this subspecies. Three birds from eastern Colombia fit well into the series, and two from Perú north of the Marañón are also well-marked. The form crosses the middle Marañón to the region between that river and the Huallaga, for seven examples from that area agree well with the lighter extremes of *frederici* from more typical localities.

In the Ucayali Valley and eastward in the southern drainage of the Amazon, the members of this species are recognizably distinct even from the paler extremes of *frederici*. They are also quite distinct from typical *simplex* and although they are, in a sense, intermediate between the other two forms, they have certain characters of their own. Since they occupy an extensive range along almost the entire southern drainage basin of the Amazon, it seems advisable to give them a distinctive name as hereunder.

Specimens from the Caura Valley in Venezuela average lighter in

<sup>1</sup> Specimen in Field Museum of Natural History, Chicago.

color than Guianan birds but skins from the region of Mt. Duida and the Rio Negro in Brazil are quite typical. The difference shown by the Caura specimens does not exceed the maximum of individual variation of Guianan birds and may not be significant.

Records are from Yurimaguas and Huambo.

*Rhytipterna simplex intermedia*, new subspecies

TYPE from Igarapé Brabo, Rio Tapajoz (left bank), Brazil. No. 287,548, American Museum of Natural History. Adult male collected June 16, 1931, by A. M. Olalla.

DIAGNOSIS.—Intermediate between *R. s. simplex* of Bahia and *R. s. frederici* of the Guianas, Venezuela, Brazil north of the Amazon, etc., but belly brighter and more yellowish and upper parts paler olivaceous than either; throat and breast more olivaceous, less grayish; upper parts more olivaceous than *frederici* but less greenish than *simplex*.

RANGE.—Brazil, south of the Amazon, from Pará west to the Rio Madeira and apparently west to the Peruvian border, extending up the Rio Madeira to the Gy-Paraná and to northeastern Bolivia; in eastern Perú on the lower Ucayali and the south bank of the Amazon east of the Ucayali.

DESCRIPTION OF TYPE.—Upper parts nearly uniform, somewhat more greenish than Deep Grayish Olive, with darker and browner centers of the feathers concealed. Lores paler and more grayish olive; auriculars slightly brownish olive; chin and throat near Light Grayish Olive, more clearly olivaceous on lower portion; breast between Grayish Olive and Light Grayish Olive; belly much brighter and more yellowish, reaching a buffy Primrose Yellow on the lower median area; under tail-coverts duller, near Deep Olive-Buff, with ill-defined brownish cross-bars. Wings dark brown, with outer margins of the remiges and the tips of the upper wing-coverts like the back; under wing-coverts like the under tail-coverts; inner margins of the remiges pale drab. Rectrices dark brown with outer margins olive. Bill and feet black. Wing, 101 mm.; tail, 91; exposed culmen, 16; culmen from base, 22.5; tarsus, 23.

REMARKS.—Females like the males but averaging smaller. Immature birds (first annual plumage?) much like the adults but wings and tail strongly margined with rufous and under tail-coverts and under wing-coverts cinnamonaceous buff.

Individual specimens of this form and of the other two forms approach each other more or less closely, but there is little difficulty in placing specimens of each from most parts of their ranges. In series, the three subspecies are easily distinguished. In fact, the new form resembles typical *simplex* more than *frederici* although the range of *simplex* appears to be cut off from that of *intermedia* more definitely than is the case with *frederici* and *intermedia*.

Specimens from a number of localities south of the Amazon, in western Brazil and eastern Perú, are not quite typical, having a brownish

tone above, rather than the olive green of *intermedia* or the gray of *frederici*. They are, however, in rather worn plumage and the brown coloration appears to be due to the exposure of the brownish sub-terminal area of the feathers which is concealed in freshly plumaged individuals. The belly is not as strongly yellow as in the fresher examples, but this, too, may easily be due to wear. Several skins show a very pronounced brown coloration on the anterior under parts which is probably a stain from some unknown cause since it is not shown by most of the specimens from the same region.

Records are from "Lower Ucayali" and probably Monterico.

#### SPECIMENS EXAMINED

*R. s. simplex*.—BRAZIL: Bahia, Cajazeiras, 3 ♂, 1 ♀; "Bahia," 5 (?); Espirito Santo, Lagoa Juparaná, 2 ♂, 3 ♀; Baixo Grande, 1 ♂, 2 ♀, 2 (?); "Brasília," 2 ♂, 1 (?) (cotypes of *Muscicapa rustica* Wied).

*R. s. intermedia*.—BRAZIL: Pará district, Prata, 1 ♂, 1 ♀; Igarapé Assú, 1 ♂; Quati-puru, 1 ♀; Utinga, 1 ♂; Rio Tocantins, Mocajuba, 1 ♂, 2 ♀, 2 (?); Baião, 1 ♀; Rio Xingú, Porto de Moz, 1 ♂, 1 ♀; Tapará, 4 ♀; Villarinho do Monte, 1 ♀; Rio Tapajoz, Igarapé Brabo, 6 ♂ (incl. type), 6 ♀; Aramanay, 1 ♂, 1 (?); Piquiatuba, 1 ♂, 1 ♀, 1 (?); Tauary, 1 (?); Itaituba, 1 ♂; Santarem, 1 (?); Diamantina, 1 ♀; Igarapé Amorin, 1 ♂; Rio Amazonas, Villa Bella Imperatriz, 2 ♂, 2 ♀; Rio Madeira, Igarapé Auará, 1 ♂; Borba, 1 (?); Calamá, 1 ♀; Rio Machados Jamarýsinho, 1 ♀; Urupá, 1 ♀; Rio Amazonas, Teffé, 2 ♀. BOLIVIA: mouth of Río San Antonio, 1 ♂; Province of Sara, "high forest," 1 ♂. PERÚ: Orosa, 1 ♀; Sarayacu, 1 ♀.

*R. s. frederici*.—DUTCH GUIANA: "Interior," 3 ♀, 1 (?). BRITISH GUIANA: Méamu mouth, 1 ♂; Tumatumari, 1 ♀; Potaro River, 2 ♂, 2 ♀; Wismar, 1 ♀; Camacusa, 2 ♂; Essequibo River, 1 (?). VENEZUELA: Río Orinoco, mouth of Río Ocamo, 1 (?); opposite mouth of Ocamo, 1 ♀; Lalaja, 1 ♂; Río Cunucunumá, Boca de Sina, 1 ♀; Mt. Duida, Caño Seco, 2 ♂; Caño León, 1 ♂; Pie del Cerro, 1 ♂; Playa del Río Base, 1 ♂, 3 ♀; Campamento del Medio, 3 ♂; Valle de los Monos, 1 ♂, 1 ♀; Río San Felix, La Cascabel, 1 ♂, 1 ♀; Río Caura, Suapuré, 1 ♂, 3 ♀; La Unión, 1 ♂, 1 ♀; La Prición, 2 ♂, 2 ♀; Río Orinoco, Perico, 1 ♂. BRAZIL: Rio Negro, Tatú, 3 ♀; San Gabriel, 1 ♂, 1 ♀; Manaos, Hacienda Rio Negro, 1 ♀; Campos Salles, 2 ♀; Igarapé Cacao Pereira, 2 ♀; Rio Uaupés, Tahuapunto, 1 ♀; Rio Jamundá, Faro, 5 ♂, 4 ♀, 1 (?). COLOMBIA: Florencia, 1 ♀; "Bogotá," 2 (?). PERÚ: Puerto Indiana, 1 ♀; Anayacu, 1 ♂; Río Negro, west of Moyobamba, 4 ♂, 1 ♀; Río Seco, 1 ♀; Puerto Melendez, 1 ♀.

#### *Rhytipterna immunda* (Sclater and Salvin)

*Lipaugus immundus* SCLATER AND SALVIN, 1873, 'Nomencl. Av. Neot.,' pp. 57, 159—"Oyapoc, Cayenne;" cotypes (♀, ♂) in British Mus.

This species is not an inhabitant of Perú but its extreme rarity and the fact that its supposed locality of origin is open to some doubt (Cf. Hellmayr, 1929, Field Mus. Nat. Hist. Publ., Zool. Ser., XIII (6), p

154, footnote) make the discovery of the bird in a new region of particular interest.

There are at hand six specimens of this interesting bird, a male from the Río Huaynia, junction of the Cassiquiare, Venezuela; two adult males, a male in juvenal plumage, and a female from Yavanari, Rio Negro, Brazil; and, most surprising of all, a male from Santarem, on the south bank of the Amazon, Brazil.

Hellmayr (*loc. cit.*) has already given the characteristics of this species and its striking similarity to *Myiarchus phaeonotus* and it is unnecessary to repeat the facts here. The birds now before me bear out Hellmayr's characterization.

The male from the Río Huaynia is in the freshest plumage and is relatively dark above, with faint traces of olive. The outer margins of the rectrices and upper tail-coverts are strongly rufous, but the margins of the remiges and longer upper wing-coverts (greater, median, and lower row of lesser series) are dull olive-buff (whiter on the tertials) with only an occasional suggestion of rufous.

The adult Rio Negro birds are more worn but are about the same color on the back as the Venezuelan skin. One male is only a little less rufescent on the tail and the upper tail-coverts, but the primaries and outer secondaries are also strongly margined with the same rufous color although the longer upper wing-coverts have only a little suggestion of it. The other adult male has the upper tail-coverts hardly brighter than the back and the rectrices are margined with buffy brown slightly tinged with tawny. The wings and the upper wing-coverts are as in the Venezuelan skin. The female from the Rio Negro is like the last-described male except that the margins of the rectrices are much darker, near Clove Brown, although the upper tail-coverts have a slight rufescent tinge on the edges. The margins of wings and longer wing-coverts are dull whitish.

The Santarem bird is somewhat paler on the back than the Rio Negro and Venezuelan skins; the upper tail-coverts are margined with a lighter hue of rufous; the margins of the rectrices are paler, near Tawny-Olive; the margins of the wings and longer upper wing-coverts are whitish with a slight touch of tawny on the inner primaries. The under parts are much as in the Rio Negro birds, somewhat paler than in the fresh Venezuelan skin. Additional material from south of the Amazon might show a recognizable distinction, but, with a single specimen, any separation would be of doubtful value.

The young male from the Rio Negro is more uniformly colored above

than the adults, a dark Hair Brown on the back with the top of the head hardly darker. The upper tail-coverts are strongly margined with rufous and the rectrices also are especially strongly rufous on the outer borders. Remiges (except the tertials) and longer upper wing-coverts have their margins definitely rufescent, a little lighter than the margins of the tail; the tertials have more whitish edges. Throat and breast are grayish with a suffusion of olive yellowish, and the belly and under tail-coverts are lighter and clearer yellow than in the adults.

In both adults and young, the outer web of the outermost rectrix is pale yellowish or whitish along the outer margin, quite different from the margins of the other rectrices.

This extension of range neither proves nor disproves the original citation of type locality. With a distribution involving the Cassiquiare, the middle Rio Negro, and the south bank of the lower Amazon, there is no reason to doubt that French Guiana may easily belong to the range of the species. The great similarity of the skins to those of *Myiarchus cephalotes* probably has caused the species to be overlooked in many places where it may easily occur. Nothing is known of its habits but it is hoped that some future student in the field will uncover these missing details.

*Lipaugus cryptolophus cryptolophus* (Sclater and Salvin)

*Lathria cryptolopha* SCLATER AND SALVIN, 1877, P. Z. S. London, p. 522—"Mongi" = Monji, eastern Ecuador; [♀?], British Mus.

Uchco, 1 ♂, 1 ♀; Cueva Seca, 1 [♂?]; Piquitambo, [Rio Tocache], 1 [♀?].

Compared with a male from Zamora, Ecuador, a male and a "♂" (? = ♀) from Sabanilla, Ecuador, and a female from Andalucia, Colombia. The series is not perfectly uniform, and without more material it is difficult to define the limits of sexual or other variation.

The Zamora skin, one bird from Sabanilla, and one from Uchco, all sexed as males, obviously are properly assignable to that sex. All have the exposed portions of the crest decidedly blackish with green tips on the lateral and posterior feathers. The basal portions of the crest-feathers are very narrowly chestnut in color on the crown, becoming pale vinaceous on the occiput where they are much broader, deepening into a chestnut color toward the middle of the feathers.

The females from Andalucia and Uchco also appear to be properly sexed and have the crest much browner on the semi-exposed parts, with a blackish tendency only at the anterior end of the region and with

green tips on most of the feathers. The bases of the feathers (or the sub-basal areas when the bases are grayish) are whitish with a buffy tinge (not as purely white as in the allied *L. c. mindoensis*), much more broadly on the occiput than on the anterior part of the crown. The crest is not so full as in the males mentioned above.

Hellmayr, when describing *mindoensis*, also described a female of *cryptolopha* from El Topo, Ecuador, which lacked all trace of a rufous spot on the crown. A female I collected at Chinchao, Perú, is of this same extreme.

The second Sabanilla bird is sexed as a male but has the crest intermediate between the two sorts described above. There is little trace of blackish on the semi-exposed portions of the feathers which are blackish chestnut with green tips or suggestions of green tips on most of them and with the bases strongly vinaceous. The bird is either a strongly marked female or a poorly marked male. The Cueva Seca specimen has the crest more brown than blackish but the median feathers are not green at the tips and the basal or sub-basal area is not strongly pale, neither whitish nor vinaceous but dull grayish. The crest, however, is long and, though somewhat defective in the specimen, appears to have been about as full as in the three males first mentioned. This bird, though no sex is given on the label, probably is a male. The Piquitambo skin has the crest least developed of all the specimens in hand, short and brown with green or greenish tips and no strongly pale bases. I judge it to be a female. It is marked as having been compared with the type, which Hellmayr has adjudged to be a female although he concluded that the Piquitambo skin was that of a male.

There is considerable variation in size in the series examined. The Zamora male has the wing 141 mm.; tail 105. Sabanilla male: wing, 138; tail, 103. Uchco male: wing, 130; tail, 100. Cueva Seca [♂?]: wing, 129; tail, 103.

Andalucia female: wing, 133 mm.; tail, 107. Sabanilla "♂": wing, 127; tail, 105. Uchco female: wing, 129; tail, 101. Piquitambo [♀?]: wing, 131; tail, 105.

The northern birds appear to average larger than the southern ones although the Sabanilla skin of doubtful sex has a shorter wing (but longer tail) than the Uchco female. More material is necessary to determine the geographical variation in size which may exist.

The Chinchao specimen is the only Peruvian one recorded in addition to the material now at hand.



# AMERICAN MUSEUM NOVITATES

Number 894

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

Dec. 31, 1936

## STUDIES OF PERUVIAN BIRDS. NO. XXIV<sup>1</sup>

### NOTES ON *PACHYRAMPHUS*, *PLATYPSARIS*, *TITYRA*, AND *PYRODERUS*

By JOHN T. ZIMMER

I am greatly indebted to Dr. Herbert Friedmann of the U. S. National Museum, Washington, D. C., for the loan of certain specimens used in the following studies.

Names of colors have been capitalized when direct comparison has been made with Ridgway's 'Color Standards and Color Nomenclature.'

#### *Pachyrhamphus spodiurus* Selater

*Pachyrhamphus spodiurus* SCLATER, 1860, P. Z. S. London, XXVIII, p. 279—  
Babahoyo, Ecuador; ♂, ♀ cotypes in British Mus.

Six specimens from northwestern Perú (Paletillas and Milagros) are referable to this west-Ecuadorian species. Five of them are females and one, from Paletillas, is a young male in molt, acquiring the adult plumage but still retaining many feathers of immaturity. Its characters are discussed in some detail in a comparative study of several allied species, given under *P. rufus*.

The females show considerable variation in the hue of rufous. The palest examples, with the crown only slightly darker than the back and the back more ochraceous than the average, appear to be young birds; the darker ones are adult. They are very like females of *rufus* except for a dusky postocular spot (sometimes developed into a narrow line around the eye or at least above it), darker grayish lores, and longer crest.

The males, in spite of the black interscapular patch and the gray under parts, have the same pattern of coloration as the males of *rufus*, including the style of marking on the upper wing-coverts and the presence of a tinge of yellow in the center of the breast. I have little doubt of the specific affinity of these two forms but prefer to leave them as distinct species until I have seen more examples of *rufus* from Perú.

The species has been recorded from Lechugal.

<sup>1</sup> Earlier papers in this series comprise American Museum Novitates, Nos. 500, 509, 523, 524, 538, 545, 558, 584, 646, 647, 668, 703, 728, 753, 756, 757, 785, 819, 860, 861, 862, and 893.



***Pachyramphus rufus* (Boddaert)**

*Muscicapa rufa* BODDAERT, 1783, 'Tabl. Pl. Enl.,' p. 27—based on "Le Gobe-mouche roux, de Cayenne," DAUBENTON, "Pl. Enl.," CDLXII, fig. 1; Cayenne (= ♀).

A single young bird from Sarayacu throws new light on the validity of several earlier records of "*cinereus*" from Perú which have been placed in the synonymy of other species by recent writers but which may, after all, have been properly allocated by Sclater and Salvin and by Taczanowski. The proof is lacking since the specimens have disappeared, and there is an added element of doubt in the fact that the three authors mentioned were not entirely clear as to the identity of the various plumages of *P. cinnamomeus*, *P. castaneus*, *P. (polychopterus) niger*, and the present species.

The three earlier records that are in doubt are from Sarayacu, Chamicuros, and Chayavitas. Unfortunately there are no descriptive notes in any of the accounts of these specimens, but only their identification as belonging to *P. cinereus*. Taczanowski's detailed descriptions in the 'Ornithologie du Pérou' were made from Cayenne specimens and are accurate enough except that he has described a young female for an adult and given a description of the adult female under the heading of a young bird (of unspecified sex).

The females of the four species are distinct enough to be readily separated in both adult and immature plumages, and the males likewise are quite distinct from each other. Nevertheless, there is no evidence that the Sarayacu, Chamicuros, and Chayavitas specimens were ever studied together, and error in their determination is not unlikely. The only specimen at hand from west of the Huallaga, suggesting the possible identity of the Chayavitas bird, belongs to the *castaneus* group, and the only specimen from east of the Huallaga, which might indicate the identity of the Chamicuros and Sarayacu records, is the young specimen of *rufus* I have mentioned. In the absence of proof to the contrary, however, I am inclined to place all these doubtful records where their original recorders placed them under "*cinereus*" = *rufus*, with some query accompanying the Chayavitas bird.

The females of *rufus* may be told in either juvenal or adult plumage by a sharp blackish line on the outer webs of the primaries and secondaries adjacent to the shafts; the outer margins are rufous. In this particular they are likely to be confused only with the females of *spodiurus* which, however, have a dusky area immediately behind the eye, a longer crest, and grayer lores.

Young females of *rufus* are much like the adults except that the rufous breast is inclined to be tinged with yellowish while the top of the head is duller, sometimes distinctly grayish over the auriculars and on the occiput; sometimes, as in the type of "*marcidus*," the whole top of the head is gray. The markings on the remiges are as in the adult. In the young females of *spodiurus* the gray behind the eye is, as in the adults, confined to a small postocular space or extended anteriorly over the orbit to the lores.

In *cinnamomeus* females, the whole outer web of the primaries and secondaries is rufous, sometimes slightly duller next to the shaft but not sharply bicolored except for the outermost primary, which has the outer web dusky with a very narrow pale margin, at least basally. The rufous crown has buffy shafts and the lores are marked by a brown or dusky spot on the lower portion, often in decided contrast to the pale ochraceous upper margin. Young females agree in this respect. The pale tips of the upper wing-coverts and the broader and flatter bill are additional characters. Adult females of *castaneus* have the outer margins of the remiges about as in *cinnamomeus*, though darker rufous, but with the outermost primary as in *cinnamomeus*; occasionally some of the subexternal remiges have a suggestion of the same marking, but it is not so pronounced as in *rufus*. The upper wing-coverts have dark centers and pale margins, giving a pattern quite different from that of *cinnamomeus*. The top of the head has the rufous coloration confined to a broad central area bordered laterally and on the nape by a broad gray band, while the rufous feathers are tipped by a spot of paler rufous or deep ochraceous. Young females are paler and duller than the adults but follow their pattern relatively closely. Both adults and young may have a slight suggestion of a dark anteocular spot but it is not pronounced if present.

Young males of *cinnamomeus* and *castaneus* are not distinguishable with certainty from the young females of the respective species, since the characteristic modification of the subexternal (ninth) primary is acquired only with the fully adult plumage and there is no other evident difference between the sexes except that the males average larger. Young males of *rufus*, however, are quite different from the young females of that species, which is not surprising in view of the differences between the adults of the two sexes. The young males have the top of the head sooty gray or blackish, at least on the lateral and posterior borders, while the central area of the pileum is brownish, variously tinged with rufous or olive. The back is variously ochreous, isabelline, or dull

rufescent buff, or even more strongly rufous, while the breast varies from Colonial Buff to a cinnamon buff not unlike that in the adult females. The wings are quite characteristic. The outer margins of the primaries are very narrowly gray, greenish-gray, or whitish, separated from the shafts by a distinct black stripe. The outer margins of the secondaries are broader and more distinct and on the inner feathers are tinged with rufous. The margins of the tertials are more definitely rufescent. The inner margins of the remiges are olive-whitish, not rufous as in the females. The upper wing-coverts have dusky or grayish centers and rufescent margins, and have distinct, dusky shafts. The tail is rufous, but there may be traces of gray somewhere on the margins or basal portions of the feathers, and the shafts are noticeably blackish in contrast to the webs.

The only young male of *spodiurus* available is the single bird of that sex from Paletillas, recorded under that species. It is in full transition from juvenal to adult dress and already has a large part of the plumage like the adult males from Ecuador. The remainder indicates a bird with a light rufous back, rufous sides of the occiput, light ochraceous breast and belly, black remiges, with the outer margins of the secondaries more rufescent than in *rufus*, and greater upper wing-coverts with the whole outer web and the tip of the inner web rufous where, in *rufus*, only the outer margin of the outer web is rufescent or ochraceous. This species also, then, should be easily distinguishable in the juvenal male plumage.

The young bird from Sarayacu is sexed as a male and agrees with the diagnosis I have given, although it is the most rufescent of a series of twelve young males I have at hand. The next in rufescence is a skin from the right bank of the lower Rio Negro, in Brazil, but one from the left bank of the lower Madeira is decidedly "yellowish" though not the yellowest of the series. The variation and the attendant possibilities suggested by these young males provide a strong probability that the type of *Muscicapa eques* Boddaert and *Muscicapa aurantia* Gmelin was a young male of the present species. The olive-brown pileum and the rufous back suffused with the same hue of green are not far from descriptive of some of the birds before me.

There are no other records of *rufus* from Perú except the doubtful ones from Sarayacu, Chamicuros, and Chayavitas.

#### SPECIMENS EXAMINED

*P. spodiurus*.—ECUADOR: Daule, 1 ♂, 1 ♀; "western Ecuador," 1 ♂; Portovel, 1 ♀; Santa Rosa, 1 ♀. PERÚ: Paletillas, 1 ♂, 3 ♀; Milagros, 2 ♀.

*P. rufus*.—FRENCH GUIANA: Cayenne, 1 ♂, 2 ♀, 1 (?); Approuague, 2 ♂;

Mana, 1 ♂. DUTCH GUIANA: Paramaribo, 7 ♂, 7 ♀; "Little Wanica," 1 ♂; Kwata, 2 ♀. BRAZIL: Faro, 2 ♂, 4 ♀; Monte Alegre, 2 ♂; Rio Negro, Igarapé Cacao Pereira, 5 ♂, 3 ♀; Campos Salles, Manaus, 1 ♂; Para, 1 ♀; Rio Tocantins, Baião, 1 ♂; Rio Xingú, Tapará, 1 ♂; Rio Amazonas, Villa Bella Imperatriz, 2 ♂, 2 ♀; Rio Tapajoz, Tauary, 2 ♂, 1 ♀; Rio Madeira, Borba, 1 ♂, 1 ♀; Rosarinho, 2 ♂; Teffé, 3 ♀. PERÚ: Sarayacu, 1 ♂. COLOMBIA: Libano, 1 ♂; Río Lima, 1 ♀; "Bogotá," 3 ♂, 1 ♀; Cali, 1 ♀; near Honda, 1 ♂. VENEZUELA: Caicara, 7 ♂, 3 ♀; Altagracia, 1 ♀; Las Barrancas, 2 ♀ (incl. type of *marcidus*), 1 (?); Cumaná, 1 ♀; San Antonio, 1 ♂, 1 ♀; San Felix, Cumaná, 1 ♂; Santa Ana Valley, 1 ♀; Cristóbal Colón, 2 ♀; Las Trincheras, 2 ♂, 1 ♀; Guanaguana, 1 ♂; Ejido, 1 ♀; Mérida, 1 ♂, 1 ♀, 1 (?); Hechisera, 3 ♂, 1 ♀; El Valle, 2 ♂, 1 ♀; Nevados, 1 ♀; Ortiza, 1 ♀; Río Mucujón, 1 ♂. PANAMÁ: (Lion Hill), 2 ♂, 1 ♀.

*P. c. cinnamomeus*.—PANAMÁ: 27 (incl. cotypes). COLOMBIA: 35. W. ECUADOR: 14.

*P. c. magdalenae*.—COLOMBIA: 2 (incl. type).

*P. c. fulvidior*.—COSTA RICA: 16. NICARAGUA: 10. GUATEMALA: 3.

#### *Pachyrhamphus castaneus saturatus* Chapman

*Pachyrhamphus castaneus saturatus* CHAPMAN, 1914 (Nov. 21), Bull. Amer. Mus. Nat. Hist., XXXIII, p. 628—La Morelia, Colombia; sex ?; American Mus. Nat. Hist.

In addition to the type of this richly colored form, I have a male and a female from Anayacu, Perú, a female from Lopuna, Perú, and a male and a female from Teffé, Brazil. The male from Anayacu is immature and is a very close match for the type which I take to be also immature. In both these birds the back is unusually dark and rufescent and the whole of the under parts likewise exceptionally deep cinnamon-ochraceous, but the plumage is of rather loose texture, the ninth primary is unmodified, the mandible is more or less whitish, and the feathers of the crest are short and neither compactly webbed nor lighter colored at the tips. These characters, except for the unusually dark coloration, are those of immaturity as exhibited by young birds of the related subspecies.

The Lopuna skin is not sexed but appears to be an adult female in worn plumage and is also very dark rufous, though not quite so dark as the two young males. The male from Teffé is adult and quite worn, and its coloration is not quite so deeply rufous as the Lopuna bird except for one or two new feathers on the mantle which show that the general hue is faded from an originally darker rufous tone. The second Teffé skin apparently is an adult female although it is sexed as a male, and is distinctly paler than the Teffé male on the under parts, though duller and a little less rufous on the back and about the same tone of deep rufous on the cap. The female from Anayacu is quite similar in these respects.

As will be seen in the discussion of the following form, some of the examples from farther down the Amazon Valley approach *castaneus* in one particular or another, but the line of separation between *saturatus* and this lower Amazonian form appears to lie between Teffé and the left bank of the Rio Madeira, or rather between the Purús and the Madeira rivers, since Hellmayr has referred birds from Caviana to *saturatus*.

The characters of the lower Amazonian birds were pointed out by Hellmayr [1929, Field Mus. Nat. Hist. Publ., Zool. Ser., XIII (6), p. 174] without a name being given to the form. The material at hand substantiates his conclusions and fully warrants the naming of the form in question which may be known as follows.

Peruvian records are from Sarayacu, Chayavitas, Chamicuros, Pebas, Río Tigre, Yurimaguas, and "upper Ucayali" (= Cashiboya?).

***Pachyramphus castaneus amazonus*, new subspecies**

TYPE from Rosarinho, Rio Madeira (left bank), Brazil. No. 282,597, American Museum of Natural History. Adult female collected May 31, 1930, by the Olalla brothers.

DIAGNOSIS.—Similar to *P. c. intermedius* of northern Venezuela, but paler above and below; belly usually pale buffy; bill larger, especially wider; tail usually distinctly shorter.

RANGE.—Amazon Valley from the left bank of the Madeira eastward, probably to the Tapajoz, crossing the Amazon to the north bank between Monte Alegre and the right bank of the lower Rio Negro; doubtfully appearing in northern Bolivia (see following text).

DESCRIPTION OF TYPE.—Top of head light Auburn, with paler, more ochraceous tips; a broad superciliary stripe commencing behind the lores, passing over the eye, and descending behind the orbit to involve the postocular space, and continued in a broad collar around the hind neck where it is lightly tinged with rufous; mantle Hazel; rump becoming much paler, near Cinnamon-Buff, but upper tail-coverts darkening on the longest feathers to near the color of the back. Lores light ochraceous on the upper portion, more whitish on the lower part; malar region and auriculars ochraceous-cinnamon; breast Cinnamon-Buff; throat paler; chin whitish; sides of breast and flanks about like malar region; belly broadly pale Pinkish Buff; under tail-coverts about like belly. Remiges dusky brown; outer webs of primaries near Sayal Brown, but on outermost primary the outer web is dusky with a very fine pale outer margin; secondaries with outer webs slightly lighter and more rufescent than the primaries; tertials with exposed portions near the color of the mantle but with paler and more ochraceous tips; primary-coverts dark brown with dull rufescent brown outer margins; upper wing-coverts much like the mantle but with poorly defined pale tips; the central portions of the greater series are somewhat darker but not in a sharply defined area; wing-lining deep Cinnamon-Buff. Median rectrices slightly darker than Hazel; succeeding ones similar but becoming somewhat paler toward the outer ones and with suggestions of pale tips. Maxilla (in dried skin) blackish, with paler tomia; mandible slaty; feet blackish. Wing, 69 mm.; tail, 49.5; exposed culmen, 12; culmen from base, 15.5; tarsus, 17.

REMARKS.—Males similar to the females but averaging somewhat larger and with the ninth (subexternal) primary modified as usual in the genus. Wing, 70.25–78 mm. (av. 75.9); tail, 48.5–56 (av. 52.7). Females measure: wing, 69–73 (av. 71.2); tail, 46–54 (av. 50.8).

The series of twenty-two birds is not entirely uniform. Occasional specimens are more warmly colored throughout than the average, with the back more strongly rufescent, the top of the head darker, and the under parts more strongly cinnamomeous, including the belly. Two males and a female from Rosarinho and a female from Igarapé Cacao Pereira, Rio Negro, are especially to be noted in this respect, suggesting *castaneus* to a greater or less extent; the top of the head, however, appears to be of a lighter hue and the gray of the supra-auriculars is paler and faintly olive-tinged.

Young birds are very decidedly paler than specimens of *castaneus* in similar plumage, and reach a greater extreme of pallidity than the adults, whereas young *castaneus* appear to be more deeply colored than adults of that form.

A single bird, without given sex but obviously an adult female, collected by Rusby and labeled as from La Paz, Bolivia, is as doubtful of identity as it is of locality. In coloration it agrees well with various specimens of *amazonus*, although the gray band above the auriculars is somewhat darker, but the size is large, even for males of the lower Amazonian form. It has a wing of 78 mm. and a tail of 56. The wing-measurement, therefore, is within the measurements of typical *castaneus* (which has a much longer tail, 61–66 mm., and much browner upper parts) while the tail-measurement comes within the range of variation in *saturatus* (51–56 mm.) which has a somewhat shorter wing (males, 73–77; females, 71.5–73.5). More material from northern Bolivia will be necessary to determine the correct affinities of this specimen, although it is hardly to be looked for at La Paz, but rather in the tropical lowlands to the northward. Apparently there is no record from anywhere on the Rio Madeira or its tributaries except near the confluence with the Amazon. On the other hand Hellmayr has recorded *saturatus* from Hyutanahan, which is some distance up the Rio Purús, suggesting the possibility that the Bolivian specimen may be from near the Falls of the Rio Madeira, not very distant from Hyutanahan.

Hellmayr likewise has assigned birds from Caviana and Manacapurú to *saturatus*. Caviana is not far distant from Rosarinho and Manacapurú is relatively near to Igarapé Cacao Pereira. Since several skins from Rosarinho and Igarapé Cacao Pereira show a tendency toward

*saturatus*, as mentioned above, the line of geographic separation between the two forms probably is not very sharply drawn.

Among the specimens examined for comparison is a male (wrongly labeled a female) from Baião, Rio Tocantins, Brazil, which furnishes a new limit of range in the species. This bird has the dark and dull dorsal coloration of typical *castaneus*; in fact it is dull even for that form, although the under parts approach *amazonus* in pallidness. The bill is at the maximum width for *castaneus* and within the limits of *amazonus*. The measurements agree much better with *amazonus* than with *castaneus* (wing, 77 mm.; tail, 55.5) since the tail is much shorter than any *castaneus* at hand except a single male from Bahia which has the same length of tail but an even shorter wing (72 mm.). The Bahia (Ituassú) bird also is slightly duller than skins of *castaneus* from farther south, and it is possible that there is a form from the region between Bahia and the Tapajoz which may be distinguished from both *castaneus* and *amazonus*. More material from this area is needed to decide this question.

Wied's specimens from eastern Brazil also are puzzling. The two skins from his collection are labeled male and female, respectively, but there is no trace of modification in the ninth primary of the supposed male and this specimen, which appears to be adult, probably is a female. There is no locality except "Brasilia" on the labels (the marked female has no original label), but since Wied's itinerary comprised only the territory between Rio and Bahia, it must be supposed that the birds came from somewhere in this area. Both are very small (wing, 64, 68 mm.; tail, 52, 51) and agree best with *amazonus* in this respect. The "♂" has the top of the head rather duller and browner than in *amazonus* and with the posterior margins of the crest-feathers quite distinctly outlined with buffy and, though it is pale (faded) beneath, it is not unlike some *castaneus* except in size. The "♀" is even paler below and in general coloration, as well as in size, is closer to *amazonus* but presumably belongs to the same form as the other Wied skin. Both birds have been marked as types (= cotypes) of "*Muscipeta aurantia* Wied," but since the name *aurantia* was quoted by Wied from earlier sources, the specimens are not even paratypes; they have no relation to the original *aurantia* which I take to be a synonym of *P. rufus* (q.v.).

#### SPECIMENS EXAMINED

*P. c. castaneus*.—BRAZIL: São Paulo, Itaituba, 1 ♀; Fazenda Cayoá, 3 ♂, 3 ♀; Paraná, Roca Nova, 1 ♀; Goyaz, Fazenda Esperanza, 1 ♀; Santa Catharina, Hansa, 1 ♀; Cerro Verde, 2 ♀; Espirito Santo, Baixo Grande, 1 ♀; Santa Barbara de

Caparaó, 2 ♀; Minas Geraes, Serra do Caparaó, 1 ♀; "Brazil," 1 ♀. PARAGUAY: Picado del Monte Caaguassú, 1 ♀; Belén, 1 ♀; La Fonciere, 1 ♀.

*P. c. castaneus*?—BRAZIL: (no locality), 1 "♂" (= ♀?), 1 ♀; Bahia, Ituassú, 1 "♂" (= ♀?); Rio Tocantins, 1 "♀" (= ♂).

*P. c. amazonus*.—BRAZIL: Rio Madeira, Rosarinho, 3 ♂, 7 ♀ (incl. type); Igarapé Auará, 2 ♀; Villa Bella Imperatriz, 2 ♂, 4 ♀; Rio Negro, Igarapé Cacao Pereira, 1 ♂, 2 ♀; Monte Alegre, Igarapé de Paituna, 1 ♂.

*P. c. amazonus*?—"BOLIVIA: La Paz," 1 ♀.

*P. c. saturatus*.—COLOMBIA: La Morelia, 1 (♂?) (type). PERÚ: Anayacu, 1 ♂, 1 ♀; Lopuna, 1 ♀. BRAZIL: Teffé, 1 ♂, 1 ♀.

*P. c. intermedius*.—VENEZUELA: Cumbre de Chiquitos, 1 ♂; San Estéban, 1 ♀; Quebrada Seca, Cumaná, 1 ♀; Cumaná, 3 ♂; Santa Ana Valley, 1 ♂, 3 ♀; La Montana de Guácharo, 1 ♀; Latal, 1 ♂; Río Neveri, 1 ♀; El Liman, 1 ♀.

### *Pachyramphus polychopterus niger* (Spix)

*Pachyrhynchus niger* SPIX, 1825, 'Av. Bras.,' II, p. 33, Pl. XLV, fig. 1—no locality; "Amazonas prope Fonteboa" suggested by Berlepsch and Hartert, 1902; ♂; type lost.

*Pachyrhamphus nigriventris* SCLATER, 1857, P. Z. S. London, XXV, p. 76—new name for *Pachyrhynchus niger* SPIX; part; north Brazil.

In the absence of the type of *niger* there is considerable uncertainty regarding the use of that name. Spix described his bird as entirely black of body and his plate figures a bird answering this description. Specimens also agreeing with it are found in Perú north of the Marañón, in eastern Ecuador, and in extreme southeastern Colombia, but on the south bank of the Amazon, embracing the region of Fonteboa, which has been posthumously selected as type locality, the males of the *polychopterus* group all have noticeable gray on the belly or crissum and usually also on the rump. Only some seven or eight males out of over fifty show any great approach toward the really blackish birds of eastern Ecuador and its neighboring localities, and of these none reaches so black an extreme. If Spix were perfectly accurate in his description, there is doubt that his type could have come from near Fonteboa.

Nevertheless, in comparison with other races of *polychopterus*, all of these birds are dark and some of them could be described roughly as black, overlooking the grayish tone of the belly or other parts. The wings frequently lack all white on the outer margins of the secondaries and there is sometimes a small amount of white in that position on the blackest western examples. The type of *niger* may have been one of the darker Brazilian birds. Spix gave no locality for his bird and may have secured it either on the south bank or on the north at Tocantins or on the Yapurá, both of which were visited by Spix or Martius. Examination of the type is the only means by which Berlepsch and Hartert's



proposal of Fonteboa as type locality could be either substantiated or refuted and, since the type is lost, Fonteboa must be taken as type locality without further question, being a place known to have been visited by Spix and being the first restricted locality proposed by any subsequent reviser.

The very dark birds of the western area may, therefore, be named and described as follows.

Records assignable to *niger* are from La Merced and the "Upper Ucayali" (= Cashiboya).

***Pachyrhamphus polychopterus tenebrosus*, new subspecies**

TYPE from Puerto Indiana, Perú, No. 230,370, American Museum of Natural History. Adult male collected June 17, 1926, by Carlos Olalla and sons.

DIAGNOSIS.—Similar to *P. p. niger* of central Brazil and adjacent regions, agreeing in the usual lack of all white markings on the scapulars and in the relatively dark coloration, but even more decidedly black; belly and rump without a definite grayish tone though upper and under tail-coverts may sometimes have a grayish or whitish admixture; white margins on outer webs of the remiges reduced or absent; under wing-coverts typically sooty, unmarked; inner margins of the remiges typically hardly paler than the rest of the web.

RANGE.—Northeastern Perú, north of the Marañón, and eastern Ecuador, extending (somewhat modified) northward into southeastern Colombia and southward across the Marañón into the region west of the Huallaga.

DESCRIPTION OF TYPE.—Top of head from forehead to nape glossy steel blue; lores and a broad superciliary duller black, with only slight bluish reflections; whole back and upper tail-coverts black, faintly glossy. Under parts entirely sooty black. Remiges black with a narrow whitish outer margin on the outermost primary; inner margins of remiges only slightly tinged with Mouse Gray. Greater upper wing-coverts black, with a small white speck at the tip of the outer web of the outer five or six feathers; median series with broader white tips; lesser series with faintly glossy bluish-black tips; under wing-coverts and axillars plain sooty black. Tail black, with white spots just short of the tips of the three outer pairs, largest on the outermost, quite small on the third pair. Bill (in dried skin) slaty black; feet black. Wing, 76 mm.; tail, 57; exposed culmen, 13; culmen from base, 15; tarsus, 17.

REMARKS.—Female not certainly separable from that of *niger* but apparently showing the maximum amount of brownish coloration on the top of the head and mantle.

A topotype has very slight whitish tips on some of the abdominal feathers, grayish-white vermiculations on the under tail-coverts, faint grayish tips on the upper wing-coverts, some grayish or whitish marks on the under wing-coverts, and white lines on parts of the outer margins of the secondaries, with broader white tips on the greater upper wing-coverts.

A male from the mouth of the Curaray is very like the type, with a

slightly gray tinge on the under tail-coverts. Another male from the same locality is not so deeply black on the belly as the type and most of the other specimens, but has an inconspicuous grayish tinge that is still far from the definite gray of *niger*.

Two males from Río Seco, west of Moyobamba, are nearer to *tenebrosus* than to *niger*, having the upper and under parts of the body equally black, although one has some gray and the other some white admixture on the under tail-coverts and under wing-coverts, and both have some whitish mottling on the inner margins of the remiges and a white margin on the outer secondary. A male from La Morelia, Colombia, is similarly varied, with the addition of slight whitish margins on more than the outermost secondary. A male from Florencia, Colombia, shows a slightly greater approach toward *niger* but remains still closer to *tenebrosus* and is quite different from several specimens of *niger* taken east of Bogotá.

The type is the only specimen lacking white at the tips of the fourth pair of rectrices (from the outside). The others are variable in this respect, as are the various specimens of *niger*, some of them having only a small speck at the tip of the fourth pair; some have traces even on the median pair.

Some males of *niger* have no white on the outer margins of the remiges (except the outermost primary), although usually there is a marked amount; the primaries (except the outermost) appear never to have more than a suggestion of whitish on the outer web. Although at its extreme development in *tenebrosus*, therefore, the uniformity of color on the outer margins of the remiges is not of particular value as a taxonomic character.

Taczanowski commented on a male from Yurimaguas as being more nearly uniform black than any other specimen he had seen, which would include a male from Tarapoto, on the same side of the Huallaga as Yurimaguas. A male from Yurimaguas, now in Field Museum of Natural History, Chicago, is marked with some gray on the lower belly and rump, like a male of *niger* from Puerto Bermúdez, Río Pichis. The region between the Huallaga and the middle Marañón is occupied, therefore, by birds of an intermediate character, being the meeting ground of *niger* and *tenebrosus*. For the present I include it in the range of *tenebrosus*.

Records assignable to *tenebrosus* are from Nauta, Pebas, and Tarapoto.

A young male and a female from southeastern Perú are indetermi-

nable as to subspecies, as is a young male from the "Lower Beni," Bolivia. Specimens from the Province of Sara, Bolivia, belong to *spixii*, but it is probable that the Beni specimen and the southeast-Peruvian birds belong to the Rio Madeira form which is *niger*. This form extends as far east as Villa Bella Imperatriz, on the south bank of the Amazon, and follows up the right bank of the Rio Negro, north of the Amazon, apparently for the entire course of the Negro and crosses westward to the base of the Andes in Colombia just east of Bogotá. Villavicencio and Buena Vista specimens show the slightly grayish belly of this middle Amazonian form, but La Morelia and Florencia skins are of the more purely black east-Ecuadorian sort. In the same way, two males from Playa del Río Base and Caño Seco, Mt. Duida, are like the middle Amazonian form, but three young males and a female from Lalaja and the mouth of the Río Ocamo, on the Río Orinoco near the foot of Mt. Duida, are more like the still paler *tristis*.

Sixty-one adult or nearly adult males from the Orinoco, northern Venezuela, Trinidad, Tobago, the three Guianas, and Brazil near the lower Amazon, at Monte Alegre, Rio Maecurú, and Marajó Island, agree in distinction from *niger* by their paler gray under parts and especially by the strong development of white on the tips of the outer scapulars, usually totally lacking in *niger* or, if present, only slightly developed. There also is a greater amount of white on the tips of the upper wing-coverts and along the outer margins of the secondaries. Contrary to what might be expected, two males from Faro, Brazil, lack this white area and, in addition, are much darker beneath than the Monte Alegre, Rio Maecurú, and Marajo males. The Faro specimens, on this evidence, must be referred to *niger*.

There also is confusion in the arrangement of the series from the south bank of the lower Amazon. Hellmayr has referred eight specimens (of both sexes ?) from Santarem to the northern form, *tristis*. I have one adult male from Santarem, six adult males from the Tapajoz and Xingú, two from northern Maranhão (Miritiba and Rosario), one from Piahy (Floriano), and four from Bahia beside the type of *polychopterus*. Granting that the type of *polychopterus* represents the Bahian form (which I shall discuss below), there is good agreement among the other males and I have no hesitation in extending the range of this form as far west and north as the left bank of the Tapajoz. These males are all markedly paler than *tristis*, with more white on the lores of some examples, and in broad characteristics resemble the distantly related *P. marginatus nanus*, especially in depth of color. In fact, a male from

Boim, secured from Madame Snethlage, was named by her, "*Pachyrhamphus marginatus*."

Whether the type of *polychopterus* belongs here or with the more southern "*spixii*" must remain questionable. Previous students have assigned the name to the Bahian form, but it is rather closer to "*spixii*." The sides of the head are decidedly blackish as in the southern birds and not so grayish as in the average of the series from Bahia to the Tapajoz, and the general tone of the under parts, now affected by post-mortem change, seems more likely to have faded from a darker hue than to have darkened from a paler one. The size is large for Bahian birds but small for the average of the southern subspecies. Nevertheless, it is not impossible that the type represents a dark example of the Bahian form, altered by age, and without proof to the contrary the name may be left as it is now established.

Turning to the Central American representatives of the species, I can find little to justify the recognition of "*similis*." Specimens from Costa Rica, Guatemala, and Nicaragua show an average broader bill than Santa Martan skins of *cinereiventris*, but the difference is not constant and is not supported by other characters of size or color. Panamanian specimens are equally variable. Griscom (1935, Bull. Mus. Comp. Zoöl., LXXVIII, p. 345) has dropped the name *similis* entirely, and I have reached the same conclusions as to its validity.

A disturbing specimen is a male collected at Lion Hill, Panamá, by McLeannan and Galbraith, referred by Ridgway to *dorsalis*, and finally placed under "*similis*" by Hellmayr. This specimen is in nearly adult plumage, except for the primaries and outer secondaries, several tail-feathers, and a few olive-tinged feathers on the uropygium (which may be first annual and not juvenal). Its general coloration is exactly that of *dorsalis* and there is no match for it among over forty males of *cinereiventris*. A male from El Villano, southeast of Santiago, Veraguas, shows an approach in pale ventral coloration, but the skin is in imperfect condition and inconclusive. More material is needed from Panamá.

Bangs and Penard (1921, Bull. Mus. Comp. Zoöl., LXIV, p. 388) called attention to the possibility of dichromatic phases in this species. The extensive series examined in the course of the present study have borne out this supposition. The authors mentioned found immature males molting into the dark extremes of adult plumage, and others from the same region changing into a lighter-hued dress, while there were fully molted examples in each extreme of pigmentation. I have at hand

material demonstrating these various points and also certain specimens in both extremes or "phases" which are renewing a plumage of the same sort. At first glance, the lighter-hued examples of the various subspecies appear to be immature and, in fact, the majority of specimens of this sort are immature, showing traces of juvenility somewhere, either in the plumage (especially in the wings, where the modified ninth primary is one of the last adult characters to be acquired) or in the bill, where the pale mandible is sometimes retained for a time after all the plumage has been renewed. Nevertheless, certain specimens are in molt from this pale dress into another equally pale, showing that it is not ascribable to delayed maturity so much as to individual variation.

On the other hand, some skins which show by the modified ninth primary that they are in adult (first or otherwise) plumage, have retained an olive tone of coloration on the rump or elsewhere, and there is reason to suspect that this tendency is continued beyond the first annual plumage. Furthermore, some adult females are unusually dark, even showing metallic reflections of a bluish cast on the top of the head although the general pattern is feminine. One young bird, sexed as a male, is in very fresh juvenal plumage, with no molt in progress, has a small cluster of adult masculine crest feathers on the right side of the occiput; the left side is equally fresh but normally juvenal as are the remiges.

Young of both sexes normally may be distinguished from adult females by the lack of the somewhat scaly tips on the feathers of the top of the head, brown in the adult female, steely blue in the adult male. Differences between the sexes of the young birds are not constant. The wings of the young males often have a blacker coloration, with a lighter tint of rufous on the tips of the upper wing-coverts, even sometimes inclined to whitish buff, and the small coverts at the radial margin may be more often only narrowly tipped with brown, allowing the blackish subterminal areas to be more or less exposed. Some females, however, recognizable by their continuing molt into similar female plumage, are like the young males in the paleness of wing-bars and the other characters mentioned.

Young males, molting from juvenal olive into the dark gray and black of the adult plumage, usually have the mandible very pale as in adult females, while young females, as a rule, have the mandible darker. Very young birds of both sexes, in which the bill is small and undeveloped, have this member quite black or with traces of paler color.

## SPECIMENS EXAMINED

*P. p. polychopterus*.—BRAZIL: (no locality), 1 ♂ (type); Bahia, 5 ♂, 2 ♀; Piauí, Floriano, 1 ♂; Maranhão, Miritiba, 1 ♂; Rosario, 1 ♂; Rio Tocantins, Arumatheua, 1 ♀; Baião, 2 ♀; Rio Xingú, Tapará, 3 ♂; Porto de Moz, 2 ♀; Rio Tapajoz, Boim, 1 ♂; Santarem, 1 ♂; Igarapé Brabo, 1 ♂, 1 ♀; Igarapé Amorin, 1 ♂; Piquiatuba, 1 ♂.

*P. p. spixii*.—BRAZIL: "Rio," 1 ♂, 1 ♀; Bemfica, Serra de Itatiaya, 1 ♀; São Paulo, Ubatuba, 1 ♂; São Sebastião, 1 ♀; Matto Grosso, Urucum, 6 ♂, 1 ♀; Belvedere de Urucum, 1 ♂, 2 ♀; Agua Blanca de Corumbá, 1 ♂; Descalvados, 1 ♂; Chapada, 3 ♂, 1 ♀; (no locality), 1 ♀. PARAGUAY: Río Negro, 2 ♂; 1 ♀; Trinidad, 1 ♂. ARGENTINA: Barracas al Sud, 2 ♂, 1 ♀; Ocampo, 2 ♂, 1 ♀; La Plata, 1 ♂; Perico, 1 ♀. BOLIVIA: Province Sara, 2 ♂; Yungas Cochabamba, 1 ♀.

*P. p. niger*.—BRAZIL: Rio Amazonas, Villa Bella Imperatriz, 6 ♂, 4 ♀; Teffé, 1 ♀; Rio Madeira, Borba, 1 ♀; Igarapé Auará, 14 ♂, 8 ♀; Rosarinho, 10 ♂, 7 ♀; Santo Antonio de Guajará, 8 ♂, 4 ♀; Porto Velho, 1 ♂; Calamá, 2 ♂; Humaythá, 3 ♂; Rio Negro, Igarapé Cacao Pereira, 6 ♂, 3 ♀; Faro, 2 ♂. VENEZUELA: Mt. Duida, Playa del Río Base, 2 ♂, 1 ♀; Caño Seco, 1 ♂. COLOMBIA: Villaviciencio, 2 ♂, 1 ♀; Buena Vista, 2 ♂. PERÚ: Santa Rosa, 5 ♂, 1 ♀; Sarayacu, 1 ♂; Lagarto, 1 ♀; Río Colorado, Chanchamayo, 1 ♂; Huachipa, 1 ♂, 1 ♀; Río Tavera, 1 ♂; Astillero, 1 ♀. BOLIVIA: "Lower Beni," 1 ♂.

*P. p. tenebrosus*.—PERÚ: Río Seco, 2 ♂; Yurimaguas, 1 ♂; Puerto Indiana, 2 ♂ (incl. type), 2 ♀; Anayacu, 1 ♀. ECUADOR: "Napo," 1 ♂; Archidona, 1 ♂, 1 ♀; mouth of Río Curaray, 3 ♂. COLOMBIA: La Morelia, 1 ♂; Florencia, 1 ♂.

*P. p. tristis*.—FRENCH GUIANA: Cayenne, 9 ♂, 1 ♀. DUTCH GUIANA: Paramaribo, 2 ♂. BRITISH GUIANA: Annai, 2 ♂; Rupununi River, 1 ♀. BRAZIL: Frechal, Rio Surumú, 3 ♂, 3 ♀; Rio Maecurú, 1 ♂; Monte Alegre, 1 ♂; Fazenda Teso, Marajó, 1 ♂. VENEZUELA: Paulo, Mt. Roraima, 1 ♀; San Antonio, Bermúdez, 1 ♂; Las Trincheras, Carabobo, 4 ♀; Cristóbal Colón, 1 ♂; Cumanacoa, 1 ♂, 1 ♀; Rincón San Antonio, Cumaná, 2 ♂; Quebrada Seca, 1 ♂; San Estéban, 3 ♂; El Pilar, 1 ♂; Caicara, 7 ♂, 1 ♀; Ciudad Bolívar, 2 ♂; Agua Salada de Ciudad Bolívar, 1 ♂, 1 ♀; Suapure, 3 ♂, 1 ♀; Altagracia, 1 ♂; Perico, 3 ♂; Maipures, 2 ♂, 1 ♀; Quiribana de Caicara, 1 ♀; La Prición, 1 ♂, 2 ♀; Las Barrancas, 2 ♂; Mérida, 1 ♂; Río Orinoco, mouth of Río Ocamo, 2 ♂, 1 ♀; Lalaja, 1 ♂, 1 ♀; "Venezuela," 1 ♂. TRINIDAD: Pointe Gourde, 1 ♂; Caparo, 2 ♂; Princetown, 6 ♂, 3 ♀; Carenage, 1 ♂. TOBAGO: Castare, 2 ♂, 1 ♀; Gecito, 2 ♂; Mariah, 1 ♂; Sandieh Point, 1 ♂; Mondiland, 1 ♂. COLOMBIA: "Bogotá," 3 ♂, 4 ♀, 1 (?).

*P. p. dorsalis*.—COLOMBIA: "Bogotá," 1 ♂; Río Barratón, 1 ♂; Río Cali, 1 ♂; Aguadita, 2 ♂, 1 ♀; San Antonio, 1 ♂; Ricaurte, 2 ♂, 1 ♀. ECUADOR: Paramba, 1 ♂.

*P. p. cinereiventris*.—COLOMBIA: Santa Marta, Bonda, 11 ♂, 7 ♀; "Saint Martha," 1 ♂. PANAMÁ: El Real, Río Tuyra, 1 ♂, 2 ♀; (Lion Hill), 1 ♂ (near *dorsalis*); Tocumé, 1 ♀; Río Chiman, 1 ♂; El Villano, 6 ♂, 2 ♀; La Colorada, 1 ♂; Agua Dulce, Coclé, 1 ♂; El Banco, Chiriquí, 1 ♂; Boquete, 1 ♂; Chiriquí, 1 ♂; Bogava, 1 ♀; Almirante, 4 ♂, 4 ♀. COSTA RICA: El Pozo, Río Terraba, 1 ♂; Buenos Aires, 3 ♂, 1 ♀; Puerto Jiménez, 2 ♂; Las Cañas, 1 ♂; Bonilla, 2 ♂; Bebedero, 2 ♂,

2 ♀; Limón, 1 ♂, 2 ♀; Juan Viñas, 1 ♂; Miravalles, 1 ♂, 1 ♀; Pozo Azul, 1 ♂. NICARAGUA: Volcan de Chinandegua, 3 ♂, 1 ♀; Chontales, 1 ♂; San Francisco, 1 ♂; Muy Muy, 1 ♂; Uluce, 1 ♂; Matagalpa, 1 ♂. GUATEMALA: Alta Vera Paz, 1 ♂; Chimoan, 1 ♂; "Guatemala," 1 ♂.

*Pachyrhamphus albogriseus salvini* Richmond

*Pachyrhamphus similis* SALVIN (nec CHERRIE, 1891), 1895, Novit. Zool., II, p. 13—Chusgon, Perú; ♂; British Mus.

*Pachyrhamphus salvini* RICHMOND, 1899, Auk, XVI, p. 186—new name for *Pachyrhamphus similis* CHERRIE.

A character of considerable value in the separation of *salvini* is found in a strong white border on the outer margin of the alula in the adult males and a similar marginal line of buff or cinnamon in the females and young males. Occasionally this is reduced in prominence, but all but a few of the specimens, including fourteen examples from Ecuador, have it well developed. It is lacking in most of the specimens of *albogriseus* and *ornatus*. The black loreal spot of *ornatus* is reduced to a less conspicuous dusky mark (as in *albogriseus*), sometimes nearly obsolete. The basal two-thirds of the median rectrices is gray, as in *ornatus*. Skins from the region of Guayaquil, Isla de Puna, Chimbo, and Punta Santa Ana, Ecuador, not only are smaller than the Peruvian birds but have the submedian rectrices also definitely gray on the inner webs for about two-thirds of the distance from the base, and may be recognized as a distinct form, described hereunder. A male from Paletillas, Perú, is not distinguishable in size from the other Peruvian birds and, although the tail is in molt, the rectricial characters appear to be those of *salvini*, so far as may be determined.

The most interesting specimens are two from Lomo Santo, south of Jaen. One of these, an adult male, has only three outer rectrices on one side and lacks all the others. It has an exceptionally large bill and long wings and legs; the dark loreal spot is large and quite blackish; the outer margin of the alula is not white but uniform with the rest of the feather; the black of the wings and tail is deep; the white of the upper part of the lores and the forehead is relatively pure (where not stained), not grayish; and the hind neck is encircled by a pale gray collar, rather well defined. The other specimen is a young male with exceptionally dark chestnut-brown crown, heavy black loreal spot, and a pale olive-gray collar on the hind neck.

These characters match those of *ornatus* of Central America, although the Lomo Santo adult is larger than my measurements for *ornatus*, having the wing 77.5 mm. as against 74 and 75 mm. for a Costa Rican and

a Panamanian male, respectively. The young Lomo Santo male has considerably more white on the throat and sides of the head than a young male of *ornatus* from Boqueron, Panamá, but I am not certain as to the value of this feature; adult males of *ornatus* have the upper part of the auriculars whiter than males of *salvini*, in which particular the Lomo Santo adult again agrees with *ornatus*.

Lomo Santo is in the general region of Jaen, apparently in the hills south of that town, at a higher elevation (5000 feet). Two males and a female from Jaen are typical *salvini*. The probability that two distinct forms occur so close together is very slight, especially since *salvini* ranges at least from 1550 feet (Paletillas) to 8500 feet (Chusgon). The two Lomo Santo specimens apparently must, therefore, be considered as very unusual examples of individual variation within *salvini*.

Taczanowski's record of two females from Lechugal, Perú, are difficult to assign without knowledge of their measurements. Lechugal is in the drainage basin of the Gulf of Guayaquil and the resident form of *albogriseus* might be expected to be the new form described below were it not that the male at hand from Paletillas, not far from Lechugal, is *salvini*. Until more material from the Tumbez region is available, the Lechugal birds must be assigned to *salvini*.

***Pachyramphus albogriseus guayaquilensis*, new subspecies**

TYPE from Chimbo, western Ecuador, altitude 1000 feet. No. 494,160, American Museum of Natural History (Rothschild Collection). Adult male collected August 21, 1897, by W. F. H. Rosenberg; original No. 758.

DIAGNOSIS.—Similar to *P. a. salvini* of northern Perú but somewhat smaller; tail of males with more gray, the subexternal pair of rectrices having the basal two-thirds definitely gray or grayish on both webs. Females not certainly distinguishable except by smaller size.

RANGE.—Western Ecuador in the Tropical Zone surrounding the Gulf of Guayaquil; probably extreme northern Perú in the same habitat.

DESCRIPTION OF TYPE.—Forehead narrowly grayish white, the posterior feathers like the crown; crown and nape glossed with steel blue; a blackish band commencing near the upper posterior border of the orbit and passing around the occiput, in part slightly glossy and not sharply defined from the general color of the pileum; hind neck gray, with slight traces of dusky in the central part; back and upper tail-coverts near Deep Gull Gray. Lores whitish, with an inconspicuous dusky anteocular spot formed largely by blackish bristly tips on the feathers; eyelids whitish; malar region and auriculars pale gray, much paler than the back; chin and throat still more whitish; breast and sides tinged with gray; belly and under tail-coverts whitish; flanks pale gray. Remiges blackish, narrowly margined with white, which is broader on the secondaries and tertiaries, but outer webs of tertiaries otherwise largely pale gray. Primary coverts similar; greater upper wing-coverts blackish, with outer margins rather broadly white; median coverts with tips white; lesser coverts with gray tips



becoming whiter on the larger feathers; alula black with white outer margin; inner margins of remiges broadly white; under wing-coverts white except for a dark patch on the under primary-coverts. Tail with median rectrices gray for most of their length, having a large subterminal blackish spot and a small white tip; subexternal pair similarly gray for two-thirds of the basal length, the terminal white very little broader than on the median pair; third pair with a basal gray area and a longer extension of gray along the outer margin and with the white tip still broader; remaining rectrices largely blackish with successively broader white tips extended on the outer web of the outermost pair more than half way to the base. Bill (in dried skin) slaty; feet blackish brown. Wing, 67.5 mm.; tail, 47; exposed culmen, 12; culmen from base, 14.5; tarsus, 17.5. In life: "Iris brown; feet bluish-gray, soles yellowish; bill pale blue, extreme tip of maxilla black" (W. F. H. Rosenberg).

REMARKS.—Females like those of *salvini* but smaller. Wing, 64–66 mm.; tail, 47–48; exposed culmen, 10.5–11.5; culmen from base, 14–15; tarsus, 17–18.

The males vary as follows: wing, 66–68.5 mm.; tail, 47–54; exposed culmen, 11–12; culmen from base, 13–14.5; tarsus, 17.25–17.5. Only one specimen has so long a tail as 54 mm.; the next in size is 48. The large bird is from Punta Santa Ana, nearest geographically to the range of *salvini* to whose measurements this specimen may show an approach.

The small size of the Chimbo bird and of a female from San Javier were noted by Hellmayr [1929, Field Mus. Nat. Hist., Publ., Zool. Ser., XIII (6), p. 190, footnote 2]. This characteristic, together with the others noted above, is similarly shown by the birds from the limited area in the Guayaquil basin of western Ecuador but not by other Ecuadorian skins, including a young male from northwestern Ecuador (Mindó). The Mindó specimen is large (wing, 72 mm.), but without definite differences being known for females and young of *salvini* and *guayaquilensis*, the measurement is the only criterion by which this specimen may be assigned to one or the other.

Two females, labeled as collected by Goodfellow and Hamilton at Archidona, have been questioned as to locality by Hellmayr, but they agree with the measurements of *salvini* and are larger than *guayaquilensis* and may have come from Archidona as stated. A male from the Río Oyacachi, not far from Archidona, belongs to *salvini*.

More Santa Martán material should be examined when possible. The single female at hand from that region has a much darker pileum than Central American skins of *ornatus* which it otherwise resembles.

#### SPECIMENS EXAMINED

*P. a. albogriseus*.—VENEZUELA: Mérida, 1 ♂; Cumaná, 1 ♂; Santa Ana Valley, Cumaná, 1 ♂; Cumbre de Valencia, 1 ♂; inland of Puerto Cabello, 1 ♀; Los Palmales, 1 ♀; Río Neverí, 1 ♀.

*P. a. ornatus*.—COSTA RICA: Navarro, 1 ♂; Bonilla, 1 ♀; (no other locality), 1 ♀. PANAMÁ: Boquete, Chiriquí, 1 ♂; Boqueron, 1 ♂, 1 ♀; Cerro Flores, 1 ♂, 1 ♀; Chitrá, 1 ♂. COLOMBIA: Valparaiso, Santa Marta, 1 ♀.

*P. a. guayaquilensis*.—ECUADOR: Chimbo, 1 ♂ (type); Guayaquil, 1 ♂; Isla Puna, 2 ♂; Punta Santa Ana, 1 ♂; Chongocito, 1 ♀; Daule, 1 ♀; San Javier, 1 ♀.

*P. a. salweeni*.—PERÚ: Chusgon, 1 ♀; Viña, 2 ♂, 1 ♀; Malca, 1 ♂, 1 ♀; (northern Perú, ex Baron, wrongly labeled "Archidona, Ecuador, Goodfellow and Hamilton"), 1 ♂; Jaen, 2 ♂, 1 ♀; Huarandosa, 2 ♂; Perico, 4 ♂, 1 ♀; Paletillas, 1 ♂; Lomo Santo, 2 ♂ (not typical). ECUADOR: Zamora, 2 ♂; Mindo, 1 ♂; Río Oyacachi, 1 ♂; "Archidona," 2 ♀.

### *Platypsaris rufus audax* (Cabanis)

*Hadrostomus audax* CABANIS, 1873, Jour. für Orn., XXI, p. 68—Monterico, Perú; ♂; Warsaw Mus.

There are but three records from Perú, the type from Monterico, a young male from Casinchiua, and a young male, now before me, from the Urubamba Valley, between Torontoy and San Miguel. I am unable to dispute or verify the assignment of Bolivian and northwestern Argentine specimens to the Peruvian form.

An item of unusual interest is the presence in the Museum collections of an adult female of this species from Mocajuba, Rio Tocantins, accompanied by a female from Fazenda Teso, San José, Isla Marajó, and another from Pará. The two last-mentioned birds were identified by Dr. E. Snethlage as *Platypsaris minor* and so recorded by her. Possibly other of her records of *minor* (females) are based on misidentifications. Perhaps, also, Pelzeln's two birds from Pará, which have been variously identified as *minor* and *rufus* are really *rufus*.

In any case, the three birds at hand show a somewhat greater extension of range for the species than has been accepted heretofore. There are no records from the state of Maranhão (unless Dr. Snethlage's record of *minor* from Tury-Assú belongs here), but the connection between the Pará district and northern Piahy should eventually be found to cross Maranhão.

### SPECIMENS EXAMINED

*P. r. rufus*.—PARAGUAY: Trinidad, 3 ♂, 2 ♀; "Paraguay," 1 ♀. BRAZIL: São Paulo, Campinas, 1 ♂; Fazenda Cayoá, 3 ♂, 1 ♀; Ypanema, 1 ♀; Itapura, 1 ♀; Itatuba, 1 ♂; "Ceara," 1 ♂; "Bahia," 3 ♂, 2 ♀; Matto Grosso, Chapada, 8 ♂, 5 ♀; Pará, 1 ♀; Fazenda Teso, San José, Isla Marajó, 1 ♀; Rio Tocantins, Mocajuba, 1 ♀. ARGENTINA: Ocampo, 4 ♂; Mocoí, 1 ♀.

*P. r. audax*.—PERÚ: Urubamba Cañon, half way between Torontoy and San Miguel, 1 ♂. ARGENTINA: Tucuman, 2 ♂; Las Cuchillas, 1 ♂, 1 ♀; La Hayada, 1 ♂, 1 ♀; Tafi Viejo, 1 ♂.

***Tityra semifasciata fortis* Berlepsch and Stolzmann**

*Tityra semifasciata fortis* BERLEPSCH AND STOLZMANN, 1896, P. Z. S. London, p. 369—La Gloria and La Merced, Perú; ♂ type from La Gloria in Warsaw Mus.

A comparative study of one hundred and twenty-six specimens of this species from the Amazonian basin has led to a new concept of the typical form and *fortis*. As is indicated by the name, *fortis* was originally separated from *semifasciata* principally because of supposed greater size, with apparently more restricted white on the inner web of the external rectrices and possibly a little more grayish tone on the under parts.

The series now at hand does not permit perfect division on these criteria nor, in fact, on any others, although there is at least one other character which is of great utility in distinguishing the two subspecies. In typical *semifasciata*, the males have the maxilla noticeably dark or even blackish for about the terminal two-thirds, often quite sharply defined from the paler base. In *fortis*, the maxilla of the males is almost entirely pale except for a very small blackish tip, and even this tip is sometimes lacking. (One male from Villa Bella Imperatriz has only the tip of the maxilla blackish, but this is an exception.) In the females of both forms, the maxilla is dark except for a basal area. The mandible is pale, without dark tip, in both sexes of both forms.

The white on the inner web of the outermost rectrices of the males is variable in both subspecies, but in *semifasciata* it is more often than not of maximum extent, commonly occupying the whole inner web of these feathers. In *fortis*, the white tip is usually quite separated from the white base by a broad blackish subterminal band. Some examples of both forms have a narrow white stripe either along the shaft or along the outer margin of the inner web, connecting the two larger white areas. Occasionally certain specimens show the tail-characters of the form other than the one to which they appear to belong.

There appears to be no valid distinction on the basis of more pronounced grayness of the under parts in *fortis*, suggested by Berlepsch and Stolzmann. I am unable also to find any definite differences in the size of the bill in the two forms. The length of wing and tail average greater in *fortis* than in *semifasciata*, but there is no sharp separation on these measurements. Arranging the specimens according to the evidence provided by various taxonomic characters and a consideration of geographical probabilities, the measurements appear as follows: *semifasciata*, ♂, wing, 110–124 mm.; tail, 62–77; *fortis*, ♂, wing, 119–136; tail, 69.5–80.5; *semifasciata*, ♀, wing, 109–121; tail 60.5–69;

*fortis*, ♀, wing, 117-131; tail 70-80.5. I have included in these measurements the figures given for the types of *semifasciata* and *fortis*.

This leaves out of consideration the birds from central Matto Grosso (Chapada) and the Rio Tapajoz where a condition occurs that is most unsatisfactory from a taxonomic point of view. The tail and bill are as in *semifasciata*, with some approach toward *fortis* in the Matto Grosso series, but the size is intermediate, approaching *fortis* more closely, even on the lower Tapajoz: ♂, wing, 120-127.5; tail, 72-76.5; ♀, wing, 114-121; tail, 68-73. If these birds are placed with *fortis* because of size, the range of that form will have a curious extension from the Matto Grosso highlands down the Tapajoz, dividing the range of *semifasciata* on the south bank of the lower Amazon. If they are placed with *semifasciata* because of the bill and tail, the measurements of that subspecies must be expanded to include the larger figures supplied by these birds. This appears to be the more satisfactory course, especially since the character of the bill is the most stable of all the various differences between the two subspecies.

Skins from Teffé are of only average *semifasciata* size, but the bill occasionally shows a tendency toward that of *fortis* and the tail is nearer the average of *fortis* in the amount of white on the outer rectrices. A single skin from Orosa, Perú, is the smallest in the series of *fortis*, but the bill and tail are typical of that form. East-Ecuadorian and southeast-Colombian specimens, heretofore referred to *semifasciata*, agree with the Peruvian birds and undoubtedly belong to *fortis* by all characteristics.

The range of *fortis* thus appears to embrace the eastern face of the Andes in southeastern Colombia, eastern Ecuador, eastern Perú (throughout the length of the country), and northern Bolivia. Possibly western Brazil, on the upper Amazon, will be found to belong here also.

Several facts have appeared in a comparative study of the other forms of the species. Thus, while *columbiana* is recorded from Mt. Sapo, southeastern Panamá, a male at hand from Tacarcuna is certainly *costaricensis*, to which several specimens from the Canal Zone (Lion Hill) also belong. To the northward, in Nicaragua, a male from León and a female from San Francisco, Río San Juan, east of San Carlos, also belong to *costaricensis* which is said to range still farther north to the Honduras boundary (Río Segovia), but five males and two females from Matagalpa, San Rafael del Norte, Savana Grande, and Volcan Viejo are rather definitely *personata* of eastern Mexico and Guatemala. The range of *personata*, therefore, should be noted as extending south into north-central Nicaragua.

A specimen of *nigriceps*, closely matching the type, is in the Rothschild collection from Santo Domingo, northwestern Ecuador. This and the type are pronouncedly different from the Esmeraldas skins at hand, including the type of *esmeraldae*, but a male from San Miguel, only a few miles from Santo Domingo, is quite like the Esmeraldas skins, showing that *nigriceps* and *esmeraldae* must be synonymous. Unfortunately the older name is based on the abnormal variant.

Peruvian records of *fortis*, including those previously assigned to *semifasciata*, are from Iquitos, Yurimaguas, Shanusi, Elvira, Jeberos, Huambo, Pisana, Monterico, "Río Ucayali," Chaquimayo, Carabaya, La Gloria, La Merced, and "Eastern Perú, forest-region" (Tschudi).

A specimen (dealer's skin from H. Whitely) is at hand, labeled "Perú," but it is a close match for various specimens of *costaricensis* from Panamá which may be its actual country of origin. It is totally unlike any Peruvian specimens I have seen.

#### SPECIMENS EXAMINED

*T. s. semifasciata*.—BRAZIL: Rio Xingú, Villarinho do Monte, 1 ♀; Rio Tapajoz, Igarapé Brabo, 4 ♂, 4 ♀; Igarapé Amorin, 2 ♂, 2 ♀, 1 (?); Caxiricatuba, 2 ♀; Rio Amazonas, Villa Bella Imperatriz, 4 ♂, 7 ♀; Rio Madeira, Borba, 2 ♂, 3 ♀; Igarapé Auará, 7 ♂, 3 ♀; Santo Antonio de Guajará, 1 ♂, 1 ♀; Rosarinho, 9 ♂, 5 ♀; Porto Velho, 3 ♂, 2 ♂, 1 ♀; Calamá, 1 ♂; Aliança, 1 ♂; Rio Juruena, Juruena, 1 ♀; Teffé, 3 ♂, 2 ♀; Chapada, Matto Grosso, 6 ♂, 2 ♀; Tapirapoan, 1 ♀; Rio Negro, Igarapé Cacao Pereira, 5 ♂, 4 ♀; Faro, 4 ♂, 4 ♀; Monte Alegre, 1 ♂.

*T. s. fortis*.—BOLIVIA: Todos Santos, 1 ♂, 1 ♀; Reyes, 1 ♀; mouth of Río San Antonio, 2 ♀; Cerro Hosane, Sta. Cruz, 1 ♂; Province of Sara, 1 ♂, 1 ♀. PERÚ: Perené, 2 ♀; Río Ucayali, Santa Rosa, 1 ♀; Pozuzo, 2 ♀; Huachipa, 1 ♂; Orosa, 1 ♂; Anayacu, 1 ♂; Puerto Indiana, 1 ♂, 1 ♀; Uchco, 1 ♂. ECUADOR: Río Suno above Avila, 1 ♂; Macas region, 2 ♂, 1 (?); "Napo," 1 ♂; Río Suno, 1 ♂. COLOMBIA: "Bogotá," 1 ♂, 1 ♀; Buena Vista, above Villavicencio, 1 ♀.

*T. s. nigriceps*.—ECUADOR: "Napo" (= probably near Gualea?), 1 ♂ (type); Santo Domingo, 1 ♂; Esmeraldas, 4 ♂ (incl. type of *esmeraldae*), 2 ♀; Chone, 1 ♂; Carondelet, 1 ♂; Paramba, 1 ♂; Pambilar, 1 ♀; San Miguel, 1 ♂. COLOMBIA: Barbacoas, 1 ♀; Yuntas, 1 ♂.

*T. s. columbiana*.—COLOMBIA: Santa Marta, Valparaiso, 2 ♂, 1 ♀; Minca, 1 ♂, 2 ♀; Cacagualito, 1 ♀; Río Cauca, Puerto Valdivia, 2 ♂, 1 ♀; Dabeiba, 1 ♂; Río Chilé, 1 ♂; Noanamá, 1 ♂. VENEZUELA: Cumbre de Valencia, 1 ♀.

*T. s. costaricensis*.—PANAMÁ: Tapalisa, 1 ♂; (Lion Hill), 2 ♂, 1 ♀. COSTA RICA: (various localities), 17 ♂, 4 ♀. "Perú" (error = Panamá?), 1 ♂. NICARAGUA: León, 1 ♂; San Francisco, Río San Juan, 1 ♀.

*T. s. personata*.—NICARAGUA: Matagalpa, 1 ♂, 1 ♀; San Rafael del Norte, 3 ♂; Savana Grande, 1 ♂; Volcan Viejo, 1 ♀. GUATEMALA: (various localities), 19 ♂, 24 ♀. MEXICO: Río Givicia, Oaxaca, 3 ♂, 1 ♀; Jalapa, 2 ♂; Santa Efigenia, Tehuantepec, 1 ♂; Tampico, Tamaulipas, 2 ♂.

<sup>1</sup> Specimens in Field Museum of Natural History, Chicago.

*T. s. griseiceps*.—MEXICO: (western localities in Jalisco, Tepic, and Sinaloa) 15 ♂, 12 ♀.

*T. s. deses*.—MEXICO: "Yucatan," 2 ♂; Chichen Itza, 2 ♂, 2 ♀.

*Tityra inquisitor albitorques* Dubus

*Tityra albitorques* DUBUS, 1847, Bull. Ac. Roy. Belg., XIV, pt. 2, p. 104—Perú.

I have no Peruvian material of this species. Apparently there are but four specimens from this country on record—the type, a male from "Perú" in the Halberstadt Museum, a male from Chayavitas in the British Museum, and a female from Yurimaguas in the Warsaw Museum.

Hellmayr has examined the male from Chayavitas and reports it as indistinguishable from specimens taken in western Ecuador and various parts of Colombia. I have a male from Teffé, Brazil, which also is indistinguishable from a west-Ecuadorian male, from certain "Bogotá" skins, and from a male from Tapalisa, eastern Panamá. Taczanowski's description of the female from Yurimaguas agrees with certain "Bogotá" females (other "Bogotá" skins of both sexes are *erythrogenys*). Hellmayr already has identified Natterer's skins from Manaos as *albitorques*. However, a female from the left bank of the Rio Madeira, near its mouth, is inseparable from *pelzelni*. On the south bank of the Amazon, therefore, the ranges of *albitorques* and *pelzelni* must meet near the mouth of the Purús. The lines of connection between Manaos and Teffé, in the range of *albitorques*, are as yet indeterminable.

Specimens are at hand from Villa Bella Imperatriz, Santarem, and Aramanay (Rio Tapajoz) that agree well enough with Matto Grosso skins to be referred to *pelzelni*. There is a great deal of variation in the extent of white on the tail in the series of eleven skins of this form, even in the Matto Grosso specimens, and any subdivision seems inadvisable.

On the other hand, examples of *erythrogenys* from the neighborhood of Faro, Brazil, are even more decidedly variable, although thirty-four specimens from the Guianas, Venezuela, and eastern Colombia are noticeably uniform. Of the eight Faro specimens at hand, one male is rather typical *erythrogenys*, although it has slight terminal white markings on some of the rectrices. Another male is similarly near *erythrogenys* but without the white tip of the tail, although the back is a little darker gray than usual. Both these birds have the basal white of the tail quite narrow. Three other males have the tail white for about two-thirds of the length, and there is a tendency toward the development of white on the lower and posterior auriculars. One of these males even has a white stripe connecting the white base and white tip along the shaft of

the subexternal rectrices, while the subterminal black band in all three specimens is narrower than in most *pelzelni*.

Three females from Faro are equally dissimilar. One has white tips on the rectrices but very little white at the base. Another has the base broadly whitish. The third has the basal white only moderately developed, with the tips also narrowly white, but on most of the rectrices there is a third white area on the inner webs about a third of the way back from the tips, tending to follow the shaft toward the white base. The back is definitely spotted or streaked as in normal *erythrogenys* and *pelzelni*.

It is not easy to say whether the Faro birds approach *albitorques*, *pelzelni*, or both. On account of the spotting of the females and because a male of *pelzelni* from Santarem exhibits some grayish white on the auricular area, as mentioned for some of the intermediate Faro birds, the relationship appears to be closer to *pelzelni* than to *albitorques*. More material from the lower Amazon is extremely desirable.

#### SPECIMENS EXAMINED

*T. i. inquisitor*.—BRAZIL: São Paulo, Victoria, 2 ♂, 1 ♀; Ituverava, 1 ♂; Alambary, 1 ♂; Fazenda Cayoá, 1 ♀; Ypanemá, 1 ♀; Minas Gerais, São Francisco, 1 ♂; Rio Jordão, 2 ♂; "Bahia," 2 ♀.

*T. i. pelzelni*.—BRAZIL: Matto Grosso, Chapada, 2 ♂; Urucum, 1 ♂; Corumbá, 1 ♂; Rio Madeira, Santo Antonio de Guajará, 1 ♀; Villa Bella Imperatriz, 1 ♂, 2 ♀; Rio Tapajoz, Santarem, 1 ♂, 1 ♀; Aramanay, 1 ♀.

*T. i. erythrogenys*.—BRAZIL: Faro, 5 ♂, 3 ♀. FRENCH GUIANA: Cayenne, 1 ♂. DUTCH GUIANA: Near Paramaribo, 1 ♂, 2 ♀. "Said to be from British Guiana," 1 ♂. VENEZUELA: San Estéban, inland of Puerto Cabello, 2 ♂, 1 ♀; Lagunillas, 1 ♀; Río Catañapa, 1 ♀; Río Caura, San Pedro, 1 ♂; Río Orinoco, Suapure, 1 ♂, 1 ♀; Perico, 1 ♀; Maipures, 2 ♂; Caicara, 5 ♂, 2 ♀. COLOMBIA: "Bogotá," 2 ♂, 2 ♀.

*T. i. albitorques*.—BRAZIL: Teffé, 1 ♂. ECUADOR: Daulc, 1 ♂. COLOMBIA: Yuntas, 1 ♂; "Bogotá," 4 ♂, 8 ♀. PANAMÁ: Tapalissa, 1 ♂.

*T. i. buckleyi*.—ECUADOR: Archidona, 1 ♀; Napo, 1 ♂; "Ecuador," 1 ♀. COLOMBIA: Florencia, 1 ♂, 1 ♀.

*T. i. fraserii*.—PANAMÁ: (Lion Hill), 1 ♂, 1 ♀; Boqueron, 1 ♂; Bugaba, 1 ♂; Natá, 1 ♂; Frances, Chiriquí, 1 ♀; Almirante, 3 ♂, 1 ♀; Espartal Isl., 1 ♀; Brava Isl., 1 ♂; Sevilla Isl., 1 ♀. COSTA RICA: Aquinares, 1 ♂; Buenos Aires, 1 ♂; Limón, 1 ♂, 2 ♀; Peratta, 1 ♀; Jiménez, 2 ♂; Guayabo, 1 ♀; Bonilla, 3 ♂, 2 ♀; Carrillo, 1 ♂. NICARAGUA: Los Sabalos, 1 ♂, 1 ♀. GUATEMALA: 2 ♂, 2 ♀, 2 (?).

#### *Pyroderus scutatus masoni* Ridgway

*Pyroderus masoni* RIDGWAY, 1886, Auk, III, p. 333—"supposed to be from the interior of Venezuela," errore = Perú; Pozuzo, Dept. Huánuco suggested, Hellmayr, 1929; U. S. Nat. Mus.

Twelve specimens from northern and central Perú have been com-

pared with the type and paratype of *masoni*. These two specimens are fragmentary, having come from native ornaments. Nevertheless, they are complete enough for detailed examination of their relationships. Dr. Chapman (1914, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 632) already has commented on these birds in comparison with a third fragment of Indian origin known to be from Perú, which agreed with the type and paratype in respect to the depth of color on the breast and the relative completeness of the black pectoral band. The home of *masoni* was thus found to be Perú and not Venezuela.

Among the twelve skins now at hand, there is not one which is as deeply colored below as the type and paratype, although one or two specimens approach it rather closely. Several specimens, in fact, are exceeded in this particular by various examples of *occidentalis* in some of which, also, the pectoral band is about as complete as in one or two of the less well marked *masoni*. It has been of interest, therefore, to discover an additional character which appears to be quite constant and which readily distinguishes *masoni* from *occidentalis*. The character is, rather, one which distinguishes *occidentalis* from all the other subspecies, since, in this particular, *masoni* agrees with all of them but *occidentalis*.

This character is found in the pattern of the individual feathers of the lower breast and belly. In *occidentalis* and *masoni*, these feathers are broadly tipped with chestnut in an extensive area. The extent of this area and the prominence of the chestnut tips are greatly reduced in the other forms although an occasional specimen of typical *scutata* shows a certain approach. In *occidentalis* the rufous tip of these feathers reaches its greatest development and extends half way basad where it meets the gray basal portion with no interruption other than for an inconspicuous buffy bar or spot, not always present. In *masoni* the rufous tip is narrower and separated from the gray base by a broad blackish or dusky brown area which, however, usually is concealed by the imbrication of the plumage, giving an impression of uniform rufescence as in *occidentalis*, until the feathers are lifted for examination. In the remaining forms, the blackish subterminal area is likewise present but, since the rufous tip is still narrower, the black is partially exposed, giving a pattern of rufous spotting on a dark background, more restricted than in *masoni* and *occidentalis*. Certain examples of *masoni*, with the rufous tips at their narrowest for that subspecies, have a limited amount of the blackish subterminal portion of the feathers exposed, but the general appearance and broad extent of the rufous area maintain their



resemblance to other specimens of *masoni* and do not suggest any of the allied forms to any marked degree.

Although the color of the lower breast and belly in *masoni* is sometimes no darker than in *occidentalis*, it has a browner and less rufescent hue. The darker examples perhaps are more rufescent but this apparent effect may be simply a greater intensity rather than a greater warmth of hue. I can find no differences in the color of the throat or of the upper breast above the black pectoral band.

Other records are from Pozuzo and Montaña de Mayro.

I am not convinced as to the distinctness of *P. s. orenocensis* without adequate material for comparison. Certainly three specimens at hand which have been identified as that form are not clearly separable from extreme examples of *granadensis*.

Typical *scutatus* bears a markedly close resemblance to *granadensis* but, besides being larger, it has a more uniformly reddish throat, with the tips of the gular feathers more broadly red and the subterminal yellow spot either obsolete or greatly reduced. The median buffy area of these feathers is much the same in the two forms, but the sub-basal black bar is somewhat stronger in *scutatus*.

#### SPECIMENS EXAMINED

*P. s. scutatus*.—BRAZIL: Paraná, Boca Nova, 1 ♀; Tacaresinho, 1 ♀; "Rio de Janeiro," 1 ♂ (?), 1 ♀ (?); Rio Grande do Sul, 1 ♂; São Paulo, Alembary, 1 ♀; Minas Geraes, Rio Jordão, 3 ♀; São Paulo, Fazenda Cayoá, 1 ♂; Belem de Descalvado, 1 ♂.

*P. s. masoni*.—PERÚ: Cushi Libertad 5 ♂, 3 ♀; Guayabamba, 1 ♂; La Lejia, 2 ♀; Río Negro, west of Moyobamba, 1 ♂; (no locality), 2 (?)<sup>1</sup> (type and paratype).

*P. s. occidentalis*.—COLOMBIA: San Antonio, 2 ♂, 3 ♀; Las Lomitas, 1 ♀; Antioquia, 1 ♂ (?); Gallera, 1 ♂; Altos de Casances, 1 ♂ (?); Cerro Munchique, 1 ♀; La Tigrerra, 1 ♀; La Florida, 2 ♂; above Salento, 1 ♂; El Roble, 1 ♂; "Bogotá," 1 ♂ (?), 3 ♀ (?); (no locality), 1 ♂ (?); Jornel, 2 ♂, 1 ♀.

*P. s. granadensis*.—COLOMBIA: "Bogotá," 5 ♂ (?), 3 ♀ (?); Tolima, 1 ♂ (?); near San Augustin, 1 ♂; La Palma, 1 ♂. VENEZUELA: Mérida, 1 ♂, 3 ♂ (?); Capás, 3 ♂, 3 ♀; Valle, 1 ♀ (?).

*P. s. orenocensis*.—VENEZUELA: Inland of Puerto Cabello, 1 ♂; Paso Honda, San Estéban Valley, 1 ♂; El Bucaral, San Estéban, 1 ♀ (?).

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<sup>1</sup> Specimens in U. S. National Museum, Washington, D. C.





# AMERICAN MUSEUM NOVITATES

Number 895

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

Dec. 31, 1936

## THE NEARCTIC ATYPIDAE

By W. J. GERTSCH

The curious spiders now comprising the Atypidae were set apart many years ago by various authors as representing a group which, though obviously closely related to the other mygalomorph species, was worthy of separation from them in some way, either as a genus, a subfamily, or a family. The genus *Atypus* dates from 1804, when Latreille used the name for the first time in a generic sense. *Aranea subterranea* Roemer, now placed as a synonym of *Atypus piceus* (Sulzer), was designated as the genotype by this same author in 1810. Ausserer in his 'Beiträge zur Kenntniss der Arachniden-Familie der Territelariae' recognized a subfamily Atypinae, which name had been used provisionally by Thorell in 1869-1870, and included three generic categories, *Calommata* Lucas, its synonym *Pelecodon* Doleschal, and *Atypus* Latreille. This author placed two of the American species in *Atypus* but erected the new genus *Madognatha* for *Sphodros abbotii* Walckenaer, assigning it to the subfamily Theraphosinae. The family name, Atypidae, was proposed by P. Bertkau in 1878 and was based on the characters presented in the German species of *Atypus*. A little later Thorell (1889-1890) divided his Territelariae into five families and for some reason substituted the name Calommatoidae for the Atypidae of Bertkau. In the 'Historie Naturelle des Araginées' Simon restored the name Atypidae and considerably enlarged the limits of the family by including twenty-four species representing six genera, and placed them in three subfamilies, the Brachybothrinae, Hexurinae, and Atypinae. Later, however, the family name was restricted to the genera *Atypus* and *Calommata* by Simon and the other genera previously included were relegated to the Aviculariidae in which they were regarded as subfamilies.

### Atypidae

Atypinae Thorell, 1869-1870, 'On European Spiders,' pp. 164-165.

Atypinae Ausserer, 1871-1875, Verh. Zool.-Bot. Gesell., Wien, XXI, pp. 13-18.

Atypinae Thorell, 1870-1873, 'Remarks on Synonyms of European Spiders,' p. 604.

Atypidae Bertkau, 1878, Archiv für Naturgeschichte, XLIV (1), pp. 356 and 362.

Calommatoidae THORELL, 1889-1890, *Studi sui Ragna Malesi e Papuani*, IV, p. 394 (footnote 2); 1891-1892, *idem*, p. 467 (Atypoidae sive Calommatoidae).

Atypidae Simon, 1892-1895, 'Histoire Naturelle des Araignées,' I, pp. 191-199 (Brachybothrinae, Hexurinae, and Atypinae).

Atypidae Simon, 1897-1903, 'Histoire Naturelle des Araignées,' II, p. 972.

Atypidae SMITH, 1908, *Ann. Amer. Ent. Soc.*, I, pp. 209-211.

Atypidae PETRUNKEVITCH, 1923, *Ann. New York Acad. Sci.*, XXIX, p. 169; 1911, *Bull. Amer. Mus. Nat. Hist.*, XXIX, pp. 94-95 (includes *Aliatypus* Smith); 1928, *Trans. Connecticut Acad. Arts and Sci.*, XXIX, p. 31 (includes *Atypus*, *Calommata*, and *Microhexura*); 1933, *idem*, XXXI, pp. 328, 345, 357, 361 and 370.

The family name Atypidae is now used in the restricted sense of Ausserer, Bertkau and Simon. The validity of such a disposition has been further substantiated by Dr. Alexander Petrunkevitch in his recent paper dealing with the internal anatomy of spiders where he has shown that *Atypus piceus* has but six cardiac ostia. The combination of characters present in the members of this small family may be tabulated as follows in what is presumably the relative importance of each.

- 1.—The heart has three pairs of ostia (Branch Scxostiateae).
- 2.—The maxillary lobes (endites) are strongly developed.
- 3.—Six spinnerets are present, the last pair primitively triarticulate, but quadriarticulate in *Atypus abboti* (Walckenaer) and *Atypus muralis* Bertkau.
- 4.—The anal tubercle is situated well above the posterior spinnerets as in the Brachybothrinae and the Liphistiidae.
- 5.—The labium is completely fused with the sternum in *Atypus*, but there is a well-marked transverse suture in *Calommata*.
- 6.—The chelicera lacks a rastellum.
- 7.—The usual groove on the lower margin of the chelicera is indistinct or obsolete.
- 8.—The sternum has four pairs of sigilla.
- 9.—A conductor of the embolus is present in the male palpus.

The presence of only three pairs of cardiac ostia, a condition shared by at least two more families of mygalomorph spiders, the Migidae and the Barychelidae, is the most important single character upon which family status for the atypids is now based. It is presumed that spiders of the subfamily Brachybothrinae of the Ctenizidae are quadriostiate, though no definite data on this point are available for any of the species. In other respects there is a nearly complete parallelism between the Atypidae and the members of this subfamily, a fact which for a time certainly warranted the use of the family name in the broad sense of Simon. Smith's objections to the restriction of the family to two genera were pertinent, but at that time the fundamental data on the cardiac ostia were not known. The atypids also parallel true spiders in many ways, particularly in the development of maxillary lobes and a conductor of the embolus in the male palpus. The following chart, based on the

characters enumerated above, illustrates the parallelism in the groups of spiders mentioned.

	ATYPIDAE	BRACHYBOTHRINAE	DIPNEUMONOMORPHAE
Heart	Sexostiate	Octostiate	Sexostiate
Maxillary lobes	Strongly	Slightly	Well developed
Spinnerets	Six	Six and four	Six, four and two
Anal tubercle	Remote from	Remote from	Near spinnerets
Labium	Fused in <i>Atypus</i>	Discrete	Discrete or fused
Rastellum	Absent	Present	.....
Sternum	Eight sigilla	Six sigilla	.....
Conductor	Present	Present	Present

The Atypidae seem clearly to be a recent offshoot of the main branch of three-clawed mygalomorph spiders. The specialization in *Atypus* is presumably more recent than in *Calommata*. This latter genus is essentially tropical in distribution in Asia and Africa. With the exception of *Atypus javanus* Thorell, from Java, the species of *Atypus* are found in the temperate zones of both the Old and the New World. Species of this genus advance farther north in Europe than representatives of any of the other four-lunged spiders. *Atypus affinis* Eichwald is found in England and, according to Nielsen, has its northern limit of distribution in Denmark, which would place it well above the 55th parallel north. The distribution of the American species is imperfectly known, but the records of *Atypus milberti* (Walckenaer) from Massachusetts, Wisconsin and New York indicate that the limits of occurrence of this species are well above the 40th parallel north. The three American atypids are confined to the eastern United States. On the west coast, however, other mygalomorph spiders (*Brachybothrium* of the Ctenizidae and *Hexura* of the Dipluridae) are found in Oregon, Washington, and Montana, and the limits of distribution of these forms will certainly be found to be well above the 50th parallel north, in British Columbia and possibly in Alberta.

The genus *Microhexura* Crosby and Bishop (1925, Ent. News., XXXVI, p. 145) is included in the Atypidae by Dr. Petrunkevitch in his 'Systema Araneorum,' but this genus seems to belong elsewhere.

It is a pleasure to acknowledge the coöperation of Dr. W. M. Barrows of Ohio State University, Mr. Wilton Ivie of the University of Utah, and Mr. H. K. Wallace of the University of Florida, to whom I am indebted for the loan of material and various data on this interesting group of spiders. The excellent drawings were done by Mr. V. Pierre Noel.

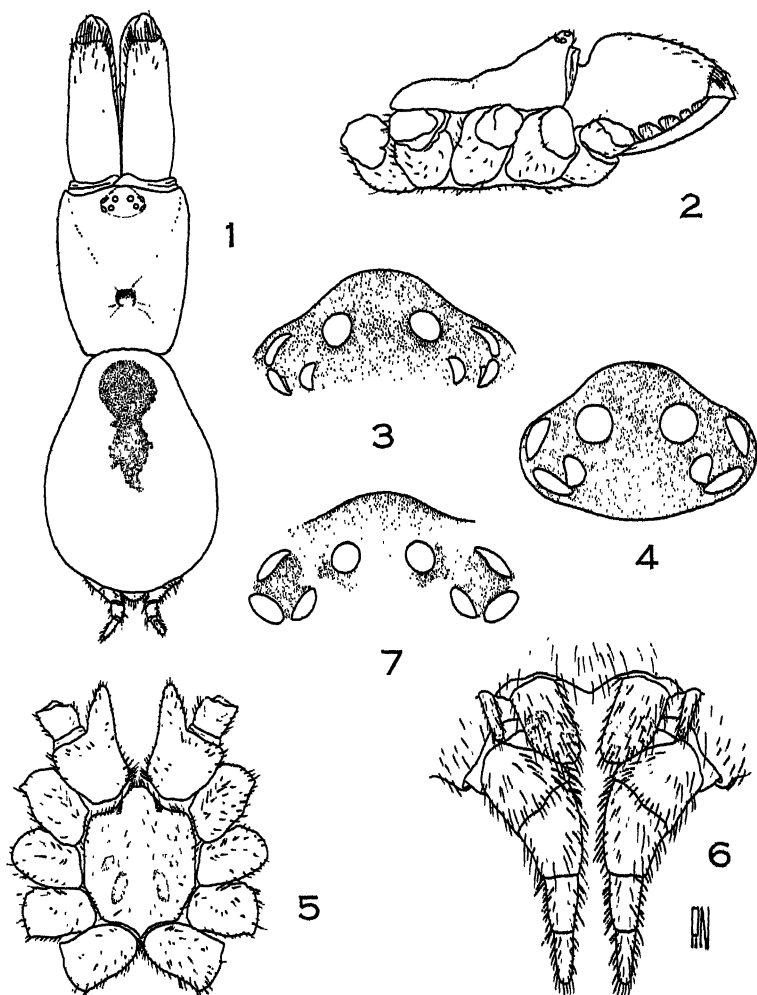


Fig. 1. *Atypus abboti* (Walckenaer), dorsal view of male, legs omitted.  
 Fig. 2. Idem, lateral view of carapace of male.  
 Fig. 3. Idem, eyes of female.  
 Fig. 4. Idem, eyes of male.  
 Fig. 5. Idem, underside of carapace of male:  
 Fig. 6. Idem, spinnerets of male.  
 Fig. 7. *Atypus bicolor* Lucas, eyes of female:

## ATYPUS LATREILLE

*Atypus* LATREILLE, 1804, Nouv. Dict. Hist. Nat., XXIV, p. 133; 1810, 'Considérations Générales des Animaux, Des Crustacés, Des Arachnides et Des Insectes,' p. 120 (*Aranea subterranea* Roemer, designated as "Type").—AUSSERER, 1871, Verh. Zool.-Bot. Gesell. Wien, pp. 131-134.—SIMON, 1892-1895, 'Histoire Naturelle des Araignées,' I, p. 198; 1897-1903, idem, II, p. 972 (Atypidae).—PETRUNKEVITCH, 1911, Bull. Amer. Mus. Nat. Hist., XXIX, pp. 94-95.—COMSTOCK, 1913, 'The Spider Book,' pp. 253-256.—SIMON, 1914, 'Les Arachnides de France,' VI (part 1), pp. 22-23.

*Oletera* WALCKENAER, 1805, 'Tableau des Aranéides,' p. 7; 1837, 'Histoire Naturelle des Insectes Aptères,' I, p. 243-245 (*bicolor*).

*Sphodros* WALCKENAER, 1837, 'Hist. Nat. des Ins. Apt.,' I, pp. 246-251 (*abboti* and *milberti*).

*Madognatha* AUSSERER, 1871, Verh. Zool.-Bot. Gesell., Wien, pp. 143-144 (*abboti*).

GENOTYPE.—*Atypus piceus* (Sulzer).

The American species of this genus agree very well in important structural details with the better known European members. The females of all the species, which are predominantly brown in color, are robust spiders with short legs, most of them less than twenty millimeters in total length when adult. The largest Nearctic species, which is quite possibly the largest member of the genus, is *Atypus bicolor* Lucas, the adult female of which sometimes attains thirty millimeters. The males are similar to the females in general appearance, the body proper being proportionately quite as robust, but they have longer legs, the tarsi of which are flexible and marked by numerous false sutures. The disparity of size between the sexes is not particularly marked in *milberti*, but is more so in *abboti* and *bicolor*, some of the difference in the smaller male being due to the less distended abdomen. In two of the American species the males are brightly colored. The male of *Atypus abbotti* has the abdomen a brilliant iridescent blue above. The bright red legs of *Atypus bicolor*, contrasted with the deep black carapace and abdomen, make this species especially striking.

All the American species have the marginal teeth on the chelicerae subequal in size as in *Atypus affinis* and *muralis*, but in the genotype, *Atypus piceus*, the teeth are unequal in size and somewhat irregular in arrangement. In the structure of the carapace and sternum *Atypus milberti* closely approaches the three European species. The four pairs of sigilla on the sternum are usually well defined, oval in shape, the caudal pair larger (see Figs. 9 and 14). In *Atypus abbotti* and *bicolor* the sternum is longer than broad and in the latter species the sigilla are characteristic in form (Fig. 13).



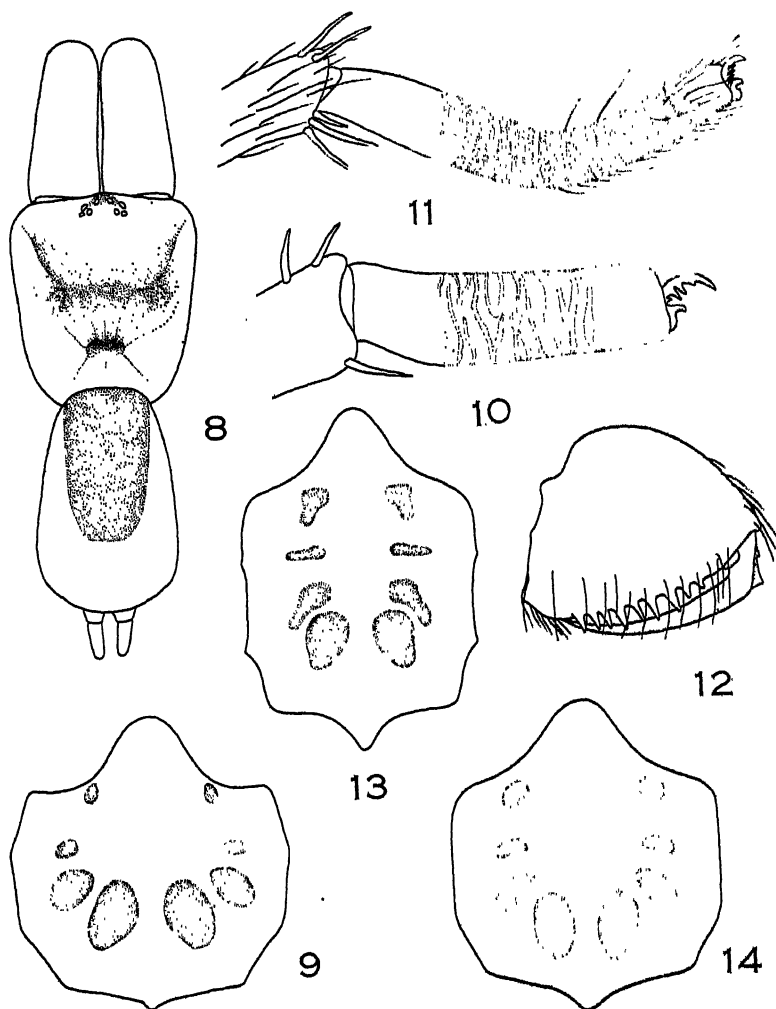


Fig. 8. *Atypus milberti* (Walckenaer), dorsal view of male, legs omitted.  
 Fig. 9. Idem, sternum of female.  
 Fig. 10. Idem, first right tarsus of male, hairs omitted.  
 Fig. 11. *Atypus abboti* (Walckenaer), first right tarsus of male, hairs omitted.  
 Fig. 12. Idem, left chelicera of female, prolateral view.  
 Fig. 13. *Atypus bicolor* Lucas, sternum of female.  
 Fig. 14. *Atypus piceus* (Sulzer), sternum of female.

The atypids have six spinnerets of which only the posterior pair has more than a single segment. *Atypus abboti* from the southeastern United States and *Atypus muralis* of Germany have the posterior spinnerets four-jointed, a character of considerable interest and of great convenience in the separation of the females. The other known species have these spinnerets triarticulate. Simon's statement in 1914 ('Les Arachnides de France,' VI, p. 23, note) that "*A. muralis* Bertkau, espèce d'Allemagne, dont je ne connais que la femelle, diffère des deux autres par ses filières supérieures quadriarticulées par suite de la division de l'article apical" is correct. The posterior spinnerets were primitively three-jointed in all the species, a condition found in the adults of both sexes of *Atypus bicolor* Lucas, *A. milberti* (Walckenaer), *A. piceus* (Sulzer), and *A. affinis* Eichwald. This is also true for the young of *Atypus abboti* (Walckenaer) and probably *A. muralis* Bertkau. However, in the adults of *Atypus abboti* and *muralis*, and probably some time before the last molt, the caudal segment becomes divided into two, the quadriarticulate spinneret resulting. Juveniles of *Atypus abboti* in one of the early stadia, when their total length is about 2.75 mm., have triarticulate posterior spinnerets. A young example in a later stadium (6.00 mm. long) has these spinnerets four-jointed as in the adult.

A short diagnosis and several illustrations (Figs. 15, 16 and 17) of a juvenile example of *Atypus abboti* are given for comparison with the adult.

Total length, including the chelicerae, 2.75 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	0.90	..	0.66	0.24	0.45	1.05 mm.
Width	0.77	0.68	0.66	0.10	0.33	0.90 mm.

Carapace bright yellow to orange, very narrowly margined in brown and marked with faint brown streaks from the indistinct median groove on the pars thoracica, the first pair defining the head portion. Carapace smooth and shining, without hairs or spines, subquadrangular in outline, truncated and broad in front, narrowed in the caudal third, rounded caudally and emarginated above the pedicel. Eyes on a black field. General form of whole spider as given in figure 15. Sternum clothed with fine black hairs, three pairs of sigilla very faintly indicated around the margins (see Fig. 16). Chelicera concolorous with the carapace, with a few black hairs distally, the margin with eight subequal teeth. Coxae and legs with a dull greenish tinge, sparsely clothed with black hairs, the legs moderately stout. Spinnerets as in figure 17, the last pair triarticulate.

The nest and the habits of one American species, *Atypus abboti*, have been studied in detail by the Reverend Henry C. McCook (1888, Proc. Acad. Nat. Sci., Philadelphia, pp. 203-222). Mr. H. K. Wallace

of the University of Florida has communicated to me a few additional notes on the habits and habitat of the species in Alachua County, Florida. He writes: "The purse-webs which *Atypus abboti* builds, and in which the spiders live, extend eight to ten inches from the ground up the sides of sweet gums, oaks, magnolias, etc., in low hammock situations. The bottoms of the webs extend several inches underground into soil that is usually black, damp and rich in organic material. Males and females build similar tubes, often on the same tree. The female keeps the young with her for a time in the web. However, the presence of miniature tube-webs on trees indicates the early departure of the young from the home nest. The males mature in June and seem to be less numerous than the females, for only twelve males have been collected to date in Alachua County. These were taken from tube-webs comparable in size and texture to those of the female."

The habits of the two northern species of *Atypus* have not been fully investigated, though it is known that both of them build purse-webs. The female of *Atypus bicolor* from Florida was taken from a web which, in keeping with the large size of the spider, was fully two feet long and placed upright against a tree. *Atypus milberti* is presumed to have this same habit. The only female of *milberti* that I have seen was not associated with its web. The males of *bicolor* and *milberti* are usually found wandering in the open. Eight males of this latter species were taken by Dr. W. M. Barrows at Cantwell Cliffs, Rockbridge, Ohio, where he found them "wandering around in the woods in broad daylight." The three American species are seemingly very local and relatively rare.

*Atypus niger* Hentz is considered here to be a synonym of *Atypus milberti* (Walckenaer). A strict comparison of specimens of *niger* with the description of *milberti* brings to light numerous discrepancies which, however, can scarcely be taken at their face value and are attributed to the faulty observation of Walckenaer.

#### KEY TO THE NEARCTIC SPECIES

- 1.—Posterior spinnerets four-jointed. Sternum and carapace longer than broad. Abdomen of male iridescent purple.....*Atypus abboti* (Walckenaer).  
Posterior spinnerets three-jointed.....2.
- 2.—Male: Legs carmine red, the carapace and abdomen black. Conductor of bulb of palpus curved, not broadened apically. Female: Carapace distinctly longer than broad. Eyes of the first row subequidistant. Sternum longer than broad, the sigilla irregularly subrectangular (Fig. 13).

*Atypus bicolor* Lucas.

ale: Legs black or dark reddish brown, concolorous with the carapace.

Conductor of bulb broadened distally. Female: Carapace as broad as or broader than long. Median eyes of the first row nearer the laterals. Sternum broader than long, the sigilla oval (Fig. 9).

*Atypus milberti* (Walckenaer).

### *Atypus abboti* (Walckenaer)

Figures 1 to 6, 11, 12 and 15 to 23

*Purse Web Spider* ABBOT, 1792, Mss. drawings of Georgia Insects, XIV, Pl. VIII, No. 36, Zool. Libr. British Mus. Nat. Hist.

*Sphodros Abbotii* WALCKENAER, 1837, Hist. Nat. des Ins. Apt., I, p. 247.

*Madognatha Abbotii* AUSSERER, 1871, Verh. Zool.-Bot. Gesell., Wien, XXI, p. 143.—MARX, 1890, Proc. U. S. Nat. Mus., XII, p. 501 (not *milberti* Walckenaer, male).

*Atypus abbotii* MCCOOK, 1888, Proc. Acad. Nat. Sci., Philadelphia, pp. 203-220, with text figures; 1893, 'American Spiders,' II, p. 138, III, Pl. XXXIX, fig. 9.

*Atypus abboti* SIMON, 1890, Actes Soc. Linn., Bordeaux, (4) XLIV, p. 308 (part); 1892, Hist. Nat. des Araignées, I, p. 198.—COMSTOCK, 1913, 'The Spider Book,' p. 253, Fig. 227.—PETRUNKEVITCH, 1911, Bull. Amer. Mus. Nat. Hist., XXIX, p. 94.

MALE ALLOTYPE.—Total length, including the chelicerae, 9.75 mm.

A medium-sized spider with black legs and carapace and an iridescent purple abdomen.

	CARAPACE	FRONT	STERNUM	LABIUM <sup>1</sup>	MAXILLA	ABDOMEN
Length	3.45	..	2.35	0.50	1.70	3.70 mm.
Width	2.85	2.50	2.00	0.75	1.20	2.70 mm.

Carapace very dark brown to black, uniformly pitted and roughened, the pars cephalica and the margins of the pars thoracica darker, armed only with a few small spines on the front face of the ocular tubercle. Carapace longer than broad, subtruncated in front, the width at this point being about eight-ninths of the greatest width of the carapace, very weakly rounded on the sides, essentially straight and narrowed to seven-ninths the greatest width between the fourth coxae (28/20), the caudal margin broadly rounded and emarginated above the pedicle. Pars thoracica irregularly flattened, the cervical groove a deep, suborbicular depression which is placed back four-sevenths of the total length (34/20) and occupies one-sixth of the width at that point. Pars cephalica very strongly elevated, convex, forming a sub-equilateral triangle as seen from above, as viewed from the side steeply declining behind the ocular tubercle and leveled off just in front of the cervical groove. Lateral and dorsal outlines of the carapace essentially as in figures 1 and 2.

Eyes on an elevated tubercle which is one-third as broad as the head in front. First row of eyes slightly broader than the second; as seen from in front procurved to the extent that a line along the upper margins of the laterals touches the lower margins of the medians, as seen from above recurved, a line along the caudal margin of the medians cutting the centers of the laterals. Ratio of the eyes: ALE:AME:PLE:PME = 17:14:14:11. Anterior median eyes separated by more than their

<sup>1</sup> The measurements of the labium are more or less arbitrary because of the fusion of the labium with the sternum.

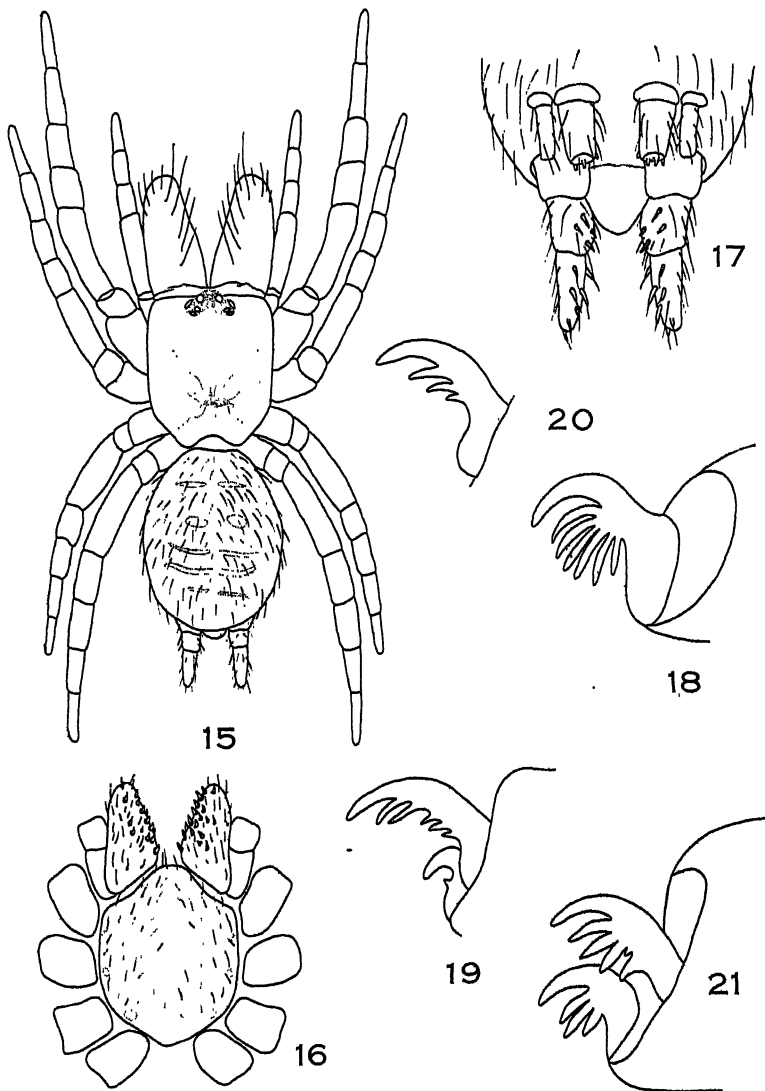


Fig. 15. *Atypus abboti* (Walckenaer), dorsal view of juvenile.

Fig. 16. Idem, underside of carapace of juvenile.

Fig. 17. Idem, spinnerets of juvenile.

Fig. 18. Idem, claw of left palpus of female, retrolateral view.

Fig. 19. Idem, proclaw and unpaired claw of first right tarsus of male, prolateral view.

Fig. 20. Idem, retroclaw of first right tarsus of male, prolateral view.

Fig. 21. Idem, retroclaw and unpaired claw of first left tarsus of female, retrolateral view.

diameter (18/14), one diameter from the larger laterals. Second row of eyes recurved, the medians separated by nearly four times their length and contiguous with the laterals. Median ocular quadrangle broader than long (6/3), narrowed in front (6/4). Lateral eyes of each side slightly separated at their bases. Curvature and eye arrangement essentially as in figure 4.

Labium and sternum light brown, with a greenish tinge, clothed evenly with short erect black hairs. Shape of under parts as illustrated in figure 5. Labium fused with the sternum, the latter with eight sigilla, a very inconspicuous pair at the base of the labium, a small pair near the margins between the first coxae, another small pair between the second coxae and a large oval caudal pair between the second and third coxae which are separated by their length, about as far from the margins of the sternum. Coxae subequal, greenish, clothed evenly with erect black hairs. Maxilla as broad as the length of the coxal portion, the endite strongly developed, set with rows of short clavate hairs on the prolateral margin, the whole maxilla otherwise evenly clothed with erect black hairs. Chelicera twice as long as broad as viewed laterally, strongly rounded above, flat on the prolateral side, convex on the retrolateral side, abruptly narrowed near the base; as seen from above three times as long as broad, roughened above, clothed with short inconspicuous black hairs and set with long curved spines and stout hairs at the distal end. Chelicera black, the claw and the denticles brown. Claw with a tooth outside near the base, gently curved. Cheliceral furrow indistinct, the ventral margin armed with nine strong teeth, the two nearest the base of the claw reduced in size, the other subequal in size, the outer side with a very thin band of black hairs.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	2.80	1.25	1.70	2.50	1.70	9.95 mm.
II	2.45	1.20	1.40	2.15	1.80	9.00 mm.
III	2.30	1.15	1.35	2.30	2.00	9.10 mm.
IV	2.80	1.30	2.00	3.10	2.25	11.45 mm.
Palp	2.10	0.80	1.50	..	1.60	6.00 mm.

Leg formula, 4132. Legs black with a greenish tinge, the tarsi light brown, relatively slender, the comparative width and length of each joint of the first leg, measured from above, indicated by the following ratios, the first number representing the width: femur (8/28); patella (5.5/12); tibia (5.6/17); metatarsus (3/25); and tarsus (2.5/17). Other legs essentially similar in relative stoutness. Legs evenly clothed with rows of black hairs, without spines above, except for one or two weak ones which occur at the distal ends of the metatarsi. Ventral spines few, the first tibia with very weak distals and one or two medians, the metatarsus with two rows of five ventrals, one or two retrolaterals, all of which are very weak. Other legs essentially as the first. All tarsi long and flexible, the distal three-fourths of the joints marked with numerous transverse false sutures, the ventral face with short curved spines. Claws three, the median small, curved, and armed with a single weak tooth. Paired claws relatively small, slightly dissimilar, the proclaws usually with five, the retroclaws with three teeth in a single series (Figs. 19 and 20). Details of the palpus as illustrated in figures 22 and 23, the conductor a strongly curved, grooved, sclerotized appendage which supports the long embolus.

Abdomen longer than broad, oval, with a median black hastate marking at the

base of the dorsum which is flanked by round pale spots, otherwise iridescent blue to purple above, the venter brown, the clothing black hairs. Spinnerets six, black, the one-jointed anterior lateral pair very small and slender (0.45 mm. long), the robust one-jointed median pair (0.65 mm.) separated by the width at base and set with white spinning tubules at the distal end. Posterior spinnerets very long, four-jointed, the lengths of the joints from base to apex, 0.50 mm., 0.55 mm., 0.45 mm., and 0.55 mm., respectively. Inner (retrolateral) margin of the ventral surface of the posterior spinnerets set with white spinning tubules. Spinnerets as illustrated in figure 6, the terminal joint of the posterior pair somewhat foreshortened.

FEMALE NEOTYPE.—Total length, including the chelicerae, 13.00 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	4.25	..	3.00	0.70	2.35	6.00 mm.
Width	3.50	3.48	3.00	1.25	2.00	5.00 mm.

Carapace light to dark yellowish brown, smooth and glabrous, the sutures infuscated, the eyes enclosing a black field. Carapace subquadrangular, broadly truncated and widest in front, nearly straight on the sides, slightly narrowed behind, the width at the third coxae, 3.00 mm., the caudal end broadly rounded and shallowly emarginated above the pedicel. Pars cephalica proportionately less elevated than in the male, broader in front, forming a triangle as seen from above. Pars thoracica flat as in the male, the cervical groove a deep depression placed back two-thirds of the total length of the carapace.

Eyes on a tubercle which is less elevated caudally than in the male and is two-sevenths as wide as the carapace at the first eye row. Eyes of the first row recurved from above, a line along the caudal edges of the medians cutting the centers of the laterals, procurved as seen from in front. Ratio of the eyes: ALE:AME:PLE:PME = 25:15:17:13. Anterior median eyes separated by more than a diameter (15/22), about as far from the larger laterals (15/20). Second row of eyes recurved, the medians separated by four diameters (13/54), contiguous with, slightly, or well separated from the lateral eyes in various specimens. Median ocular quadrangle broader than long (77/34), narrowed in front (77/47), the eyes subequal. Lateral eyes of each side subcontiguous or slightly separated. Curvature and eye arrangement essentially as in figure 3.

Sternum and labium yellowish brown, the structure much as in the male (Fig. 5), clothed with short erect black hairs. Sternum as broad as long, with eight sigilla, the two anterior pairs occasionally absent or poorly defined. Maxilla clothed with black hairs, the endite well developed, set with numerous short clavate hairs (spinules). Chelicera powerful as in the male but proportionately shorter, three-fourths as broad as long as viewed from the side, the lower margin armed with nine teeth, as in the male, and with an additional very small tooth retrolaterad of the basal tooth.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	3.20	1.60	1.20	1.43	1.00	8.43 mm.
II	2.50	1.60	0.96	1.23	0.85	7.14 mm.
III	2.20	1.40	0.85	1.20	0.80	6.45 mm.
IV	2.60	1.55	1.20	1.60	1.05	8.00 mm.
Palp	1.80	0.97	0.80	..	0.95	4.52 mm.

Leg formula, 1423. Legs dusky yellowish brown, stout, the comparative width and length of the joints of the first leg, measured from above, indicated by the following ratios, the first number representing the greatest width: femur (8/32); patella (7/16); tibia (7/12); metatarsus (5/15); and tarsus (3.7/10). Last leg slightly stouter than the first. Second and third legs proportionately very much stouter. Legs clothed with short black and longer dark hairs, some of them bristle-like, otherwise very sparsely spinose. First tibia with a distal ventral pair, five dorsals and a single prolateral, all small; first metatarsus with a small median dorsal spine. Second leg with a distal dorsal spine, the tibia with two distal dorsals and the metatarsus with a ventral pair and fifteen dorsals, and the tarsus with three dorsal spines, all very small. Metatarsus of the third leg with eleven prolaterals, fourteen retrolaterals and a ventral pair, some of the laterals nearly dorsal in position. Fourth leg spined essentially as the first. Claws very small, the single palpal claw with six teeth (Fig. 18), the unpaired claws of the tarsi usually with three teeth, the paired claws essentially similar, with four or five teeth in a single series, the proclaws occasionally lacking one denticle (Fig. 21).

Abdomen suboval in outline, dark brown, with small round pale spots. Posterior spinnerets four-jointed, the proportions as in the male.

TYPE LOCALITY.—Georgia, females (Walckenaer, 1837).

DISTRIBUTION.—Georgia and Florida.

RECORDS.—Georgia: (Abbot, 1792); (Walckenaer, 1837); (McCook, 1888); (Simon, 1890). Florida: Fairyland, Georgiana, Brevard County, females (McCook, 1888); near Gainesville, Alachua County, May 25, 1933, male and three immature males (H. K. Wallace), April 1, 1933, females (H. K. Wallace), April 18, 1933, females, one designated as the neotype (H. K. Wallace), February 22, 1933 (H. K. Wallace), June 19, 1935, four males, one designated as the allotype (H. K. Wallace), June 12, 1935, four males, females (Ivie, Wallace and Gertsch); Sugar Foot, Alachua County, May 25, 1933, male, female (H. K. Wallace); Alachua County, October 31, 1933, young (H. K. Wallace); Quincy, Gadsden County, November 28, 1934, female (H. K. Wallace); Leon County, April 16, 1936, female (James Rogers and H. K. Wallace); Lake City (Comstock, 1913); Crescent City (Simon, 1890).

#### *Atypus bicolor* Lucas

Figures 7, 13, 24, 25, and 28, 29

*Atypus bicolor* LUCAS, 1836, Ann. Soc. Ent. France, V, p. 213, Pl. v, fig. 5; 1840, Hist. Nat. Crust. Arachn., p. 344.—SIMON, 1890, Actes Soc. Linn., Bordeaux, (4) XI, IV, p. 309.—MARX, 1890, Proc. U. S. Nat. Mus., XII, p. 499.—BANKS, 1910, Bull. U. S. Nat. Mus., LXXII, p. 1.—PETRUNKEVITCH, 1911, Bull. Amer. Mus. Nat. Hist., XXIX, p. 94.—COMSTOCK, 1913, 'The Spider Book,' p. 256, Fig. 227.

*Oletera bicolor* WALCKENAER, 1837, Hist. Nat. des. Ins. Apt., I, p. 245.

MALE.—Total length, including the chelicerae, 14.50 mm.

A large species with black carapace, abdomen and palpi, but with strikingly colored carmine-red legs.



	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	5.40	..	3.30	0.65	2.80	5.00 mm.
Width	4.70	4.25	3.30	1.30	2.00	3.50 mm.

Carapace deep black, uniformly pitted and roughened as in *abboti*, without spines. Carapace longer than broad, subquadrangular in outline, broadest in front, the sides nearly straight, the width at the third coxae, 3.75 mm., the caudal margin rounded and shallowly emarginated above the pedicel. Structure of the pars cephalica as in *abboti*, the cervical groove a conspicuous deep depression one-fifth as wide as the carapace at that point, placed back seven-elevenths of the total length of the carapace.

Eyes on a tubercle similar to that of *milberti*, the caudal margin not strongly elevated, equal in width to one-fourth of the width of the carapace at the second eye row. First row of eyes procurved from in front, very weakly recurved from above, essentially straight. Ratio of the eyes: ALE:AME:PLE:PME = 22:17:14:12. Anterior median eyes separated by more than a diameter (17/25), nearly as far from the laterals (17/21). Second eye row recurved, the medians separated by five diameters (12/65), subcontiguous with the laterals. Median ocular quadrangle broader than long (90/33), narrowed in front (90/54). Eye arrangement and curvature as in the female (Fig. 7).

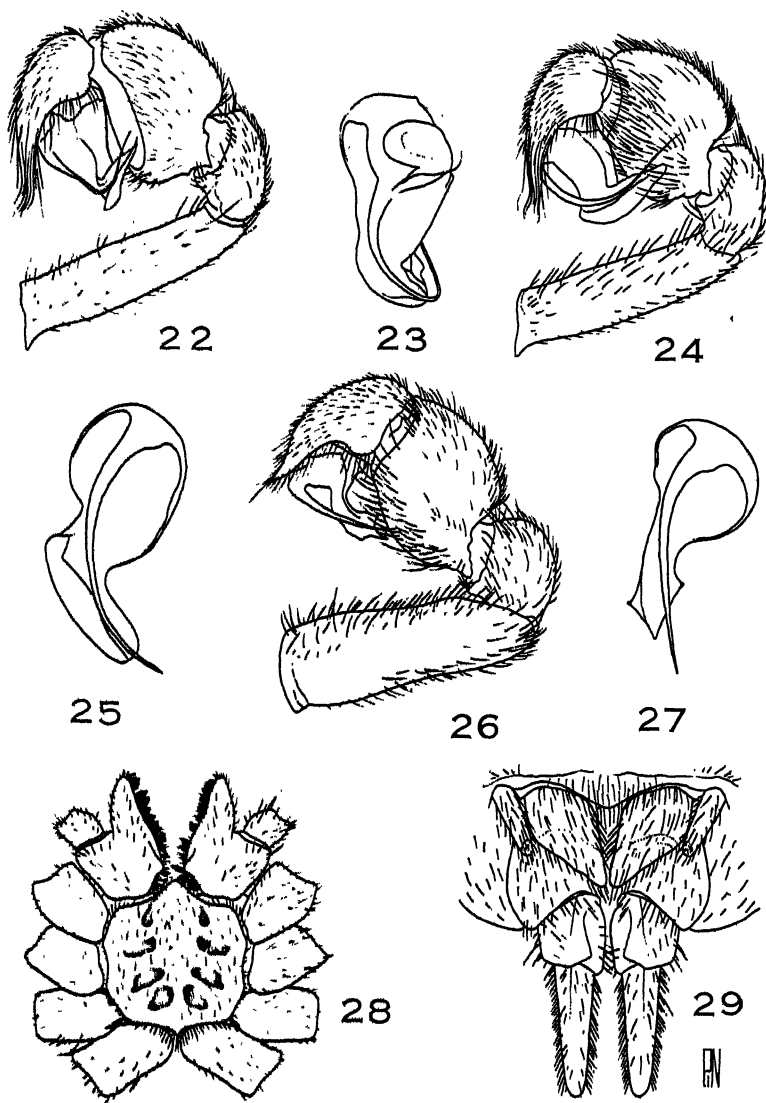
Structure of the under side of the carapace much as in *abboti*. Sigilla of the sternum more deeply impressed, characteristic in shape, the first pair at the base of the labium well indicated (Fig. 28). Coxae and trochanters of the legs and all the joints of the palpus dark brown to black. Clothing of the sternum and maxillae erect black hairs. Coxal portion of the maxilla as long as broad at the base, the endite well developed, with a promarginal band of pale hairs. Chelicera powerful, 4.30 mm. long as seen from above, 1.40 mm. broad at the base, roughened, especially so on the prolateral side, clothed apically with curved hairs and spines. Lower cheliceral margin with a single series of eleven teeth, nine of them very large, the basal two smaller. Claw very long, weakly curved, with a small tooth near the base just above the margin on the outer side.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	4.65	2.00	2.25	3.40	2.00	14.30 mm.
II	4.00	2.00	1.90	3.15	1.80	12.85 mm.
III	3.40	1.65	1.65	3.35	1.70	11.75 mm.
IV	4.25	2.00	2.35	4.40	2.20	15.20 mm.
Palp	3.00	1.20	1.75	..	2.00	7.95 mm.

Leg formula, 4123. Legs in the living specimens described as carmine red, faded in the alcoholic material to bright orange. Legs rather slender and essentially like those of *abboti* in relative stoutness, the spination similar. Claws as in *abboti*. Palpus as illustrated (Figs. 24 and 25), much as in *abboti* but the conductor strongly geniculate and heavier.

Abdomen deep black, with an elongate, moderately sclerotized scutum on the dorsum. Spinnerets as in *milberti*, the posterior pair three-jointed (Fig. 29).

FEMALE.—Total length, including the chelicerae, 22.50 mm.



- Fig. 22. *Atypus abboti* (Walckenaer), left male palpus, retrolateral view.  
 Fig. 23. Idem, conductor and embolus of left male palpus, terminal view.  
 Fig. 24. *Atypus bicolor* Lucas, left male palpus, retrolateral view.  
 Fig. 25. Idem, conductor and embolus of left male palpus, terminal view.  
 Fig. 26. *Atypus milberti* (Walckenaer), left male palpus, retrolateral view.  
 Fig. 27. Idem, conductor and embolus of left male palpus, terminal view.  
 Fig. 28. *Atypus bicolor* Lucas, under side of carapace of male.  
 Fig. 29. Idem, spinnerets of male.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	7.40	..	4.65	0.85	3.50	10.00 mm.
Width	6.50	6.20	5.30	2.00	2.70	7.00 mm.

Color and structure essentially as in *abboti*. Carapace longer than broad, subquadrangular, narrowed behind, the width at the third coxae, 4.80 mm. Cervical groove a deep transverse depression one-fifth as wide as the width of the carapace at that point (22/5), placed back five-sevenths of the total length. Eyes as in figure 7. Sternum essentially as in the male but much more narrowed behind, the sigilla in the same position and of the same shape (Fig. 13).

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	5.10	2.60	1.80	2.50	1.35	13.35 mm.
II	4.00	2.50	1.60	2.25	1.35	11.70 mm.
III	3.75	2.15	1.15	2.25	1.00	10.30 mm.
IV	4.00	2.70	1.60	2.65	1.35	12.30 mm.
Palp	3.00	1.50	1.30	..	1.20	7.00 mm.

Leg formula, 1423. Legs and tarsal claws as in *milberti*. Posterior spinnerets three-jointed, essentially as in the male (Fig. 29). Abdomen dark brown, with a round sclerotized plate at the base of the dorsum.

TYPE LOCALITY.—North America (locality not given).

DISTRIBUTION.—District of Columbia. Florida. Maryland.

RECORDS.—District of Columbia: male and female; Plummer's Island, near Washington, male (Banks collection) (Comstock, 1913, p. 256). Florida: Gadsden County, July 7, 1934, female Allotype, collected by R. E. Bellamy. Maryland: Camp Roosevelt, June, 1935, two males (H. S. Barber).

### *Atypus milberti* (Walckenaer)

Figures 8 to 10 and 26, 27

*Sphodros milberti* WALCKENAER, 1837, Hist. Nat. des Ins. Apt., I, p. 249.

*Atypus abbotti* SIMON, 1890, Actes Soc. Linn., Bordeaux, (4) XLIV, p. 308 (Part).

*Atypus milberti* BANKS, 1907, 31st Ann. Rpt. Dept. Geol. Nat. Res., Indiana, (1906), p. 736; 1910, Bull. U. S. Nat. Mus., LXXII, p. 1.—PETRUNKEVITCH, 1911, Bull. Amer. Mus. Nat. Hist., XXIX, p. 95.

*Atypus niger* HENTZ, 1842, Jour. Boston Soc. Nat. Hist., IV, p. 224, Pl. viii, fig. 1; 1875, 'Spiders U. S.', p. 19, Pl. ii, fig. 1 (reprint).—AUSSENER, 1871, Verh. Zool.-Bot. Gesell., Wien, XXI, p. 134.—MARX, 1890, Proc. U. S. Nat. Mus., XII, p. 449.—PETRUNKEVITCH, 1911, Bull. Amer. Mus. Nat. Hist., XXIX, p. 95.—EMERTON, 1913, Bull. Amer. Mus. Nat. Hist., XXXII, p. 259, Text Figures 1a-1c.

MALE NEOTYPE.—Total length, including the chelicerae, 10.50 mm. A uniformly black, robust species of medium size.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	3.90	..	2.50	0.50	2.20	4.50 mm.
Width	4.05	3.60	2.75	0.90	1.70	3.00 mm.

Carapace very dark reddish-brown to black, the pars cephalica darker, pitted and roughened, without hairs or spines except for some small ones on the ocular tubercle. Carapace longer than broad, truncated in front and broadest there, gently rounded on the sides and narrowed behind, the width at the fourth coxae, 3.30 mm., broadly rounded behind and shallowly emarginated above the pedicel. Cervical groove a deep transverse depression two-ninths as wide as the width of the carapace at that point, situated back three-fourths of the total length. Structure of the carapace essentially as in *abboti* but proportionately much broader (Fig. 8).

Eyes on a prominent tubercle, not so strongly elevated caudally as in the male of *abboti*, which occupies about one-fourth of the width of the carapace at the first eye row (9/39). Ratio of the eyes: ALE:AME:PLE:PME = 16:11:13:11. First row of eyes as broad as the second, procurved from in front, recurved as viewed from above, the medians separated by two diameters (11/20), one diameter from the laterals. Second row of eyes recurved, the medians separated by four diameters (44/11), subcontiguous with the laterals. Median ocular quadrangle broader than long (63/25), narrowed in front (63/40). Lateral eyes of each side subcontiguous.

Under side of the carapace uniform dark reddish brown to black, sparsely clothed with short erect black hairs. Sternum broader than long, with four pairs of sigilla in the usual position, essentially as in figure 9, which represents the female, the large posterior sigilla, however, separated by nearly the long diameter. Coxal portion of the maxilla broader than long, the endite well developed, with a thin band of hairs on the prolateral side and a few short clavate spines. Chelicera twice as long as broad as seen from above, with eleven large subequal teeth on the margin. Claw of the chelicera with a poorly developed tooth on the outer side at the base.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	3.30	1.55	1.45	2.15	1.35	9.80 mm.
II	2.75	1.65	1.25	2.00	1.48	9.13 mm.
III	2.70	1.35	1.20	2.25	1.48	8.98 mm.
IV	3.00	1.40	1.70	3.10	1.75	10.95 mm.
Palp	2.15	0.90	1.50	..	1.35	5.90 mm.

Log formula, 4123. Legs dark reddish brown to black, slender, but more robust than in *abboti*, the comparative width and length of the joints of the first leg, measured from above, indicated by the following ratios, the first number representing the greatest width: femur (9/33); patella (8/15); tibia (8/14); metatarsus (5/21); and the tarsus (3.5/13). Other legs essentially similar in relative stoutness. Legs clothed with rows of black hairs. Spines all weak, placed much as in *abboti*. Tarsi proportionately shorter and consequently less flexible than in that species, ringed with false sutures in the distal two-thirds of the joint (Fig. 10). Details of the palpus as illustrated in figures 26 and 27, the embolus a long, relatively weakly curved spine, the conductor broadened and triangular at the distal end.

Abdomen dark reddish brown to deep dull black, with a smooth brown sclerotized basal plate. Spinnerets six, the small lateral pairs and the robust median pair placed nearly in a transverse line, the long posterior pair three-jointed, the basal joint, 0.45 mm., the median, 0.55 mm., and the apical joint, 0.80 mm. long.

FEMALE ALLOTYPE.—Total length, including the chelicerae, 17.00 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	5.10	..	3.50	0.80	3.00	.....
Width	5.40	5.00	4.35	1.80	2.30	.....

Carapace, appendages and under side dark reddish brown, clothed with black hairs. Structure of the carapace essentially as in the male.

Eyes on a tubercle which is rounded and prominent in front but which is lower behind, merging evenly with the pars cephalica behind and practically on the same plane, the width equal to one-sixth the width of the head at the second eye row. Ratio of the eyes: ALE:AME:PLE:PME = 25:17:17:17. First row of eyes procurved from in front, weakly recurved as seen from above, a line through the centers of the laterals cutting the caudal fifth of the median eyes. Anterior median eyes separated by more than a diameter (25/17), much nearer the laterals (25/10). Second eye row recurved, the medians separated by over three times their long diameter (55/17), subcontiguous with the laterals. Median ocular quadrangle broader than long (80/39), narrower in front (80/54). Lateral eyes of each side subcontiguous.

Sigilla of the sternum placed as in the male, the prominent caudal pair nearer together as figured (Fig. 9). Cheliceral margin with twelve large subequal teeth. Tooth on fang near the outer distal end weakly developed.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	3.35	1.95	1.35	1.60	1.20	9.45 mm.
II	2.80	1.80	1.05	1.45	1.00	8.10 mm.
III	2.45	1.80	0.85	1.50	0.80	7.40 mm.
IV	3.00	1.85	1.25	1.80	1.25	9.15 mm.
Palp	2.20	1.30	1.10	..	1.15	5.75 mm.

Leg formula, 1423. Legs all very stout, spines essentially as in the female of *abbotti*. Abdomen imperfect, the spinnerets completely broken off and lost, the posterior spinnerets presumably three-jointed as in the male.

TYPE LOCALITIES.—Male type of *Sphodros milberti* Walckenaer from Philadelphia, Pennsylvania (Walckenaer, 1837). Male type of *Atypus niger* Hentz from Northampton, Massachusetts (Hentz, 1842).

DISTRIBUTION.—Northeastern United States, from Massachusetts to Wisconsin and south to Ohio, Pennsylvania and North Carolina.

RECORDS.—Massachusetts: Northampton, male (Hentz, 1842). New York: Cornwall on the Hudson, May 30, 1913, male Neotype (Emerton, 1913), in the collection of The American Museum of Natural History. New Jersey: "Palisades opposite the northern part of New York City," "several young *Atypus* in their tubes" (N. Banks) (Emerton, 1913, p. 260). Wisconsin: no specific locality (Peckham) (Simon, 1890, p. 308, as *abbotti*). Illinois: Princeton, Bureau County, May 13, 1933, male (T. H. Hubbell); Riverside, May 30, 1912, male. Indiana: Wyandotte, September 8; New Harmony (Dransfield) (Banks, 1906).

Ohio: Marietta (W. Holden) (J. H. Emerton, in Hentz, 1875, p. 19, footnote to the species); Cedar Point, August 15, 1913, female allotype from the stomach of a frog (Carl Drake), identified as *milberti* by Dr. Banks; Cantwell Cliffs, Rockbridge, June 18, 1926, eight males (Dr. W. M. Barrows); Put-In Bay, June 26, 1927, male (Dr. C. H. Kennedy). D. C.: Washington (Marx) (Simon, 1890, p. 308, as *abboti*). North Carolina: no specific locality (McCook), probably this species (Simon, 1890, as *abboti*).



A REVERSED ALMOST WHOLLY AMBICOLORATE  
SUMMER FLOUNDER, *PARALICHTHYS DENTATUS*

By E. W. GUDGER

This specimen, the most abnormal flounder that has ever come into my hands, was taken at Freeport, Long Island, July 21, 1935. It was presented to the Museum by Mr. Lawrence Mortimer of Garden City, Long Island, to whom go my best thanks for this remarkable specimen. It is most abnormal in that it is reversed—i.e., it points to the right when it should point left; and it is ambicolorate—i.e., its under surface, instead of being white, is almost wholly dark.

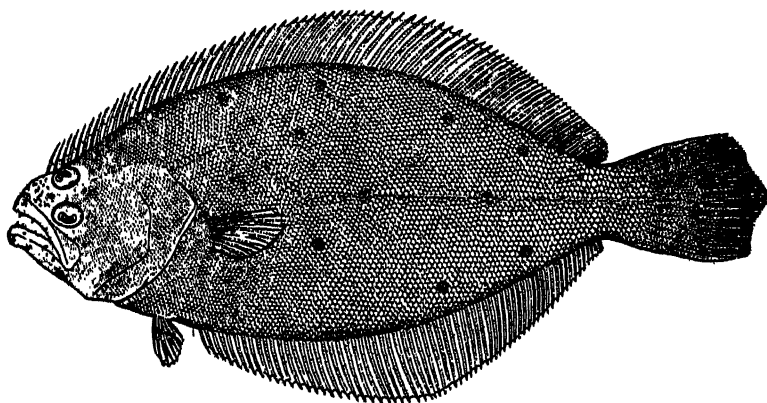


Fig. 1. Upper side of a normal *Paralichthys dentatus*. The normal fish is left-handed, i.e., the fish points left and has eyes and color on the left side.

After Jordan and Evermann, 1900.

## THE NORMAL FISH

In order that the reader may have a basis for understanding just how abnormal this specimen is, it will be necessary to give a figure and brief description of the normal fish. This, as shown in Fig. 1, is a sinistral, left-pointing or left-handed fish, having eyes and color on the left side and the right side blind and colorless. The color of the upper side varies with the bottom on which it is found, but in its southern range at



any rate it is generally a light olive with many small white spots on the body, and still smaller ones on the vertical fins (not shown, however, in the figure). In addition there are on the upper side 10 to 15 rather large dark spots with white borders.

*P. dentatus* is a western Atlantic flounder ranging from Massachusetts (Cape Cod) to Florida. Except the halibut, it is the largest of our east coast flatfishes. It grows to a length of 3 ft. and a weight of 26 lbs., but the average weight is about 3 lbs. My specimen measures 15 in. over all, and weighs 1 lb. 1 oz. It is then a comparatively small summer flounder.

#### THE REVERSED FISH

Since this specimen is abnormal on both sides it will be necessary carefully to study both surfaces. That side will be taken up first which the observer would see first.

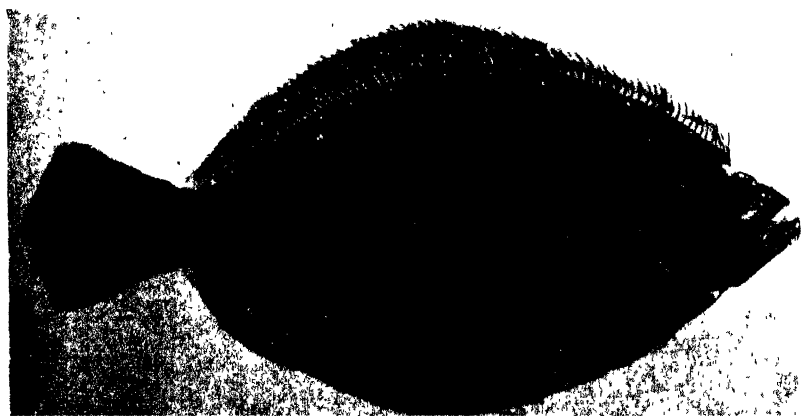


Fig. 2. The upper, or eyed and colored side of the reversed or right-handed summer flounder. Note the number and position of the spots, also the hooked dorsal fin and the incompletely rotated eye.

#### A.—THE UPPER OR DARK SIDE

Fig. 2 shows that the normally left-handed *P. dentatus* has become right-handed in this specimen. It is eyed and colored on the right side instead of on the left. In reversal the color of the left side has come over to the right. This is not an unusual phenomenon in flatfishes, but in this specimen it is noteworthy that the spots normal to the left side have come over along with the general coloration to the right side.

Noticable are the 15 large dark spots with white rings. Three of these are on the lateral line; and if this ran straight forward to the mouth, then a fourth would also be on it. Four are found well up toward the base of the dorsal, and four near the anal fin. Further these dorsal and anal spots show a certain bilaterality with reference to the median line of the body and with regard to each other. Then along the bases of dorsal and anal fins, and on these fins, are many small white spots of indeterminate number. Presumably in the normal fish there is some variation in the number and arrangement of these spots. What and where these would have been on a normal fish, one cannot say, but I dare conjecture that their number and arrangement in this reversed specimen are what they would have been on the left side of this fish had it not been reversed.

In ambicolorate flounders, specimens have been recorded in which dorsal spots have been reproduced on the ambicolorate lower surface. But this seems to be the first figure and record showing the reproduction of spots on a reversed flounder. At least I found none in a recent paper<sup>1</sup> on reversal, in which I studied every account that I could find of this phenomenon.

When this reversed flounder is looked at from its functional upper side, one sees not merely that this side is colored, but that the head shows certain anomalies. Compared with the normal fish, the travelling eye has not come over to its normal position but has stopped nearly on the dorsal crest. Furthermore the anterior end of the dorsal fins ends in a curious hook. Attention is called here to these anomalies; they will be discussed in the next section.

#### B.—THE LOWER OR AMBICOLORATE SIDE

Even after a year in alcohol the under side of this fish is of a decidedly olive hue. The color is lighter than that of the upper side, but it is surely ambicolorate. As Fig. 3 shows, the under side is everywhere dark save for the white on the hinder part of the pectoral fin and on the head proper. On the top of the head, the dark color comes over from the upper side—barely over in front of the eye, but markedly over under and behind the eye and under the hooked dorsal fin. The dark color covers the opercles and the lower jaw. In other words the white head proper is framed in dark.

Of particular interest is the number (15) of the large spots on the

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<sup>1</sup> Gudger, E. W. 'Abnormalities in Flatfishes (Heterosomata). I. Reversal of sides: a comparative study of the known data.' Jour. Morphol., 1935, LVIII, 1-39, 5 figs.

lower side of this fish. About 12 of them in their positions fairly duplicate those of the upper side. The careful insertion of a needle through the center of each of the 12 lower spots shows that each is a duplicate of that on the upper side. Sometimes the needle comes out squarely in the center of the upper spot, sometimes the lower is placed eccentrically with regard to the upper spot, and in a few cases the needle narrowly misses the upper spot. But the spots on the lower side surely in a fairly accurate way duplicate those above.

Also of especial interest are the head anomalies. The left or rotating eye has its left edge just on the dorsal ridge, so evidently so that the eye is plainly visible from the blind side. Overhanging the hinder edge of the eye is the hooked anterior part of the dorsal fin. The point of the hook is curiously enough white on the lower side but it is dark on the upper side.



Fig. 3. The left or lower ambicolorate side of this reversed summer flounder. The whole lower side is dark save the central part of the head and the pichald pectoral fin. Note the number and position of the spots. The rotating eye is still visible and is overhung by the hooked dorsal fin.

This almost wholly ambicolorate flounder in its color and its head anomalies conforms to the general rule. This is that when the whole lower body and approximately one-third of the head is dark, then there will be found an incompletely rotated eye and a hooked dorsal fin.

This specimen is unique among flounders. There has been but one other reversed ambicolorate flatfish described. In 1907, Cunningham<sup>1</sup>

<sup>1</sup> Proc. Zool. Soc. London, pt. 1, pp. 174-181, 2 figs.

figured and described a reversed turbot partially ambicolorate on the blind side and white on the eyed side. However, it was only 44 mm. (1.7 in.) long—hardly more than a post-larval fish, whereas my specimen is an adult. In addition to the flounder herein described, I have two reversed partially ambicolorate halibuts. These will be described later, and still later I plan to bring together and study all these reversed ambicolorate flatfish in the endeavor to find an explanation of this double anomaly.



# AMERICAN MUSEUM NOVITATES

Number 897

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

Dec. 31, 1936

## AMBICOLORATION, PARTIAL AND COMPLETE, IN THE SOUTHERN FLOUNDER, *PARALICHTHYS LETHOSTIGMA*

By E. W. GUDGER

The American Museum's collection of teratological fishes was enriched late in 1934 by the incoming of two ambicolorate summer flounders taken in Louisiana waters. Press of other work has delayed study of these until now. This is fortunate, since in March, 1936, there came from Norfolk a third ambicolorate specimen of this flounder. The three make a perfect series. The brief history of each will be given later. So far as I can find there is no previous record of ambicoloration in *Paralichthys lethostigma*.

The summer flounder is a western Atlantic heterosomate fish. It has been recorded from New York, but there it is sometimes confused with *Paralichthys dentatus*. It is most common from North Carolina south along the Atlantic coast, throughout the Gulf, and as far east as Trinidad. It is much given to penetrating sounds and ascending rivers.

### THE NORMAL FISH

*Paralichthys lethostigma* is a sinistral or left-pointing fish, without any marked peculiarities of form or color. Hence it does not seem necessary to publish a figure of the normal fish. The right or rotated eye is found well across on the left side of the dorsal crest. The color of the upper side is a dark olive-brown with some rather obscure darker mottlings. It is often confused with *P. dentatus*, which, however, has a number of small dark ocellated spots particularly on the dorsal part of the upper side. Preserved specimens of both fishes have much the same color and are best distinguished by their gill-rakers—12 on the first arch in *P. lethostigma* and 14—17 (occasionally 12—13) on the first arch in *P. dentatus*.

The southern flounder grows to a considerable size, the largest fish (so far as recorded) being two feet long. This specimen, according to H. M. Smith,<sup>1</sup> was taken at Plymouth, North Carolina, from the Roanoke River.

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<sup>1</sup> "The Fishes of North Carolina." N. C. Geol. and Econ. Survey, Raleigh, N. C., 1907, p. 388.

## TWO PARTIALLY AMBICOLORATE SPECIMENS

These two fish are of different degrees of ambicoloration and form a two-fish series leading up to specimen no. 3. Figures and descriptions follow.

## A PARTIALLY AMBICOLORATE FISH

## WITHOUT EYE AND DORSAL FIN ANOMALIES

This specimen was found in the New Orleans fish market by Mr. Milton Lindner of that city on October 11, 1934. Its history could not be traced, but it probably came from some point on the Louisiana or on the near-by Mississippi coast. This well-preserved fish measures from tip of snout to tip of caudal fin 365 mm. (14.4 in.), and weighs 368.5 grams (13 oz.). It is probably an average-sized summer flounder.

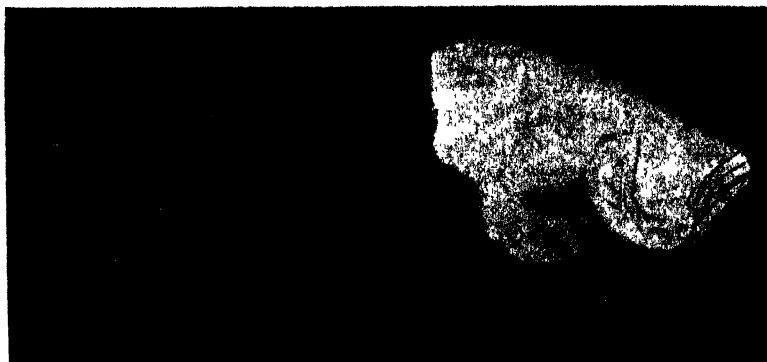


Fig. 1. Lower surface of a partially ambicolorate *Paralichthys lethostigma*. Note absence of eye and dorsal fin anomalies.

Specimen from Mr. Milton Lindner.

The upper side of this sinistral fish is entirely normal in every respect, but the lower or right side presents an interesting case of partial ambicoloration (Fig. 1). Nearly  $\frac{3}{5}$ ths of the lower surface is of the same dark color as the upper surface as Fig. 1 shows. The limit of the dark area above the lateral line is a nearly perpendicular line located 8.25 in. from the tip of the tail. Below the lateral line, the line of demarcation inclines obliquely downward a distance of about 2 in., then turns forward and upward to the base of the pectoral fin. This dark lower surface is an inch wide to the tip of the anal fin, but widens out forward from this point. This fin, the area above it to the edge of the operculum,

the base of the pectoral, and almost its whole area are dark. The whole anal fin is dark. The dorsal fin, forward of a line from the middle of the pectoral, is white. So is the ventral edge of the body anterior to the anal fin. As Fig. 1 shows the whole lower head and a large part of the forward part of the body are white.

As is the general rule, when the whole lower head and the larger anterior part of the lower side are uncolored, there are no other anomalies. The eye has crossed the dorsal crest and has come to rest in its normal position on the left side, and the anterior part of the base of the dorsal fin is likewise absolutely normal. This fish is a perfectly normal partially ambicolorate flounder of the group having the whole lower head and part of the anterior section of the body white.

Mr. Lindner kindly writes me that on August 30, 1934, he saw another partially ambicolorate southern flounder in the fish market in New Orleans. The under side of this was colored like the upper surface, save that the head was white. There were no eye nor dorsal fin anomalies. Unfortunately this specimen (about 20 in. long) was too large to be preserved.

AN ALMOST TOTALLY AMBICOLORATE FISH  
WITH EYE ALMOST OVER DORSAL CREST AND WITH A HOOKED  
DORSAL FIN

This fine specimen was collected by Mr. E. L. McIlhenny in the vicinity of Avery Island, Louisiana, on June 11, 1929. It is slightly smaller than the other specimens, measuring 335 mm. (13.2 in.) in total length and weighing 354 grams (12.5 oz.). This fish came to me in fine condition.

The upper side of the body seems entirely normal until one notices (Fig. 2) that the right or rotating eye is out of its normal place, is high upon on the dorsal ridge with its right edge arrested on the dorsal crest. This eye is overhung by the anterior base of the dorsal fin, under which is a deep backwardly-extending cavity—i.e., the anterior dorsal fin-edge is deeply hooked. Two other minor things may be mentioned. As Fig. 2 shows there is a small white patch obliquely placed behind the rotated eye, there are white blotches in front of this eye, and the anterior point of the hook is white. These are not artifacts, but I cannot account for their presence nor do I perceive their significance.

However, when one turns to the under surface, there is found a truly remarkable condition. The rotated eye is just over the dorsal crest and is plainly visible from the lower side. The whole under surface of the



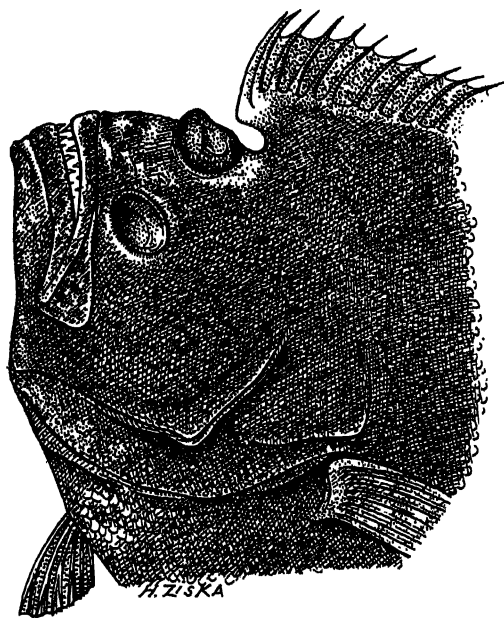


Fig. 2. Upper side of head of a partially ambicolorate southern flounder. Note the eye which is barely over the dorsal crest, and the white patches behind it. Note also the hook of the dorsal fin white on the point.

Specimen from Mr. J. C. Pearson.



Fig. 3. Lower or blind surface of the flounder of Fig. 2. Note the white lower head framed in black, the right eye still showing just over the dorsal crest, and the overhanging hooked dorsal white on the point.

Specimen from Mr. J. C. Pearson.

body including dorsal, caudal and anal fins is as dark as the upper one. The pectoral fin away from the base is white, and the pelvics are white on their inner or lower surfaces. The edge of the abdomen and the ventral edge of the opercle are white almost to the chin. The lower head (Fig. 3) is white with an almost complete encircling rim of dark on it. About half of the upper jaw and all of the lower are dark. The opercle is quite black save on the upper edge. This is balanced off by a dark area on the hinder cheek. Above, a dark area projects forward above the head as far as the front edge of the eye. Between eye and snout, the white area extends over the median crest onto the left side. The point of the hook on the lower side is white but hardly so much so as the upper side. One can sum up by saying that the lower head proper is framed in black, and that, except for this white head and the pectoral fin, the whole lower surface is black. Seen on the lower surface are certain rather ill-defined spots. Indefinite as these are they are more marked than those on the upper side. Careful insertion of a needle in these lower spots shows that each is directly opposite (underneath) a corresponding upper side spot.

This almost totally ambicolorate flounder exemplifies the rule for such extreme ambicoloration. This rule is that this large amount of dark under surface is accompanied by the two head anomalies of an incompletely rotated eye and a hooked dorsal fin.

#### A COMPLETELY AMBICOLORATE SPECIMEN

##### WITH INCOMPLETELY ROTATED EYE AND HOOKED DORSAL FIN

This specimen was found among other flounders on a fish-landing pier at Norfolk, Va., in March, 1936, by Mr. F. E. Firth of the U. S. Bureau of Fisheries. Its place of capture can be given only approximately as on the trawling grounds S. S. E. of Chesapeake Light, which lies about 12 mi. out from the mouth of Chesapeake Bay. This is the most definite northern record of its capture on our Atlantic coast.

This fish is 295 mm. (11.6 in.) long over all, and weighs 226.8 grams (8 oz.). It came up from Norfolk frozen, and unfortunately was not thawed out before being placed in alcohol. And more unfortunately it was not pinned out on a board during the pickling process. As a result it has become badly crumpled and twisted. For these reasons it has not been possible to have the lower surface photographed—to my great regret. However, I have had both sides of the head drawn. This distortion has caused protrusion of white under-throat and gill parts as shown in the figures.

Seen from the upper or sinistral side, this fish is entirely normal save in the head region as shown in Fig. 4. The right eye is barely over the dorsal crest. In fact its right or lower edge is hardly over the ridge. Overhanging this eye is the deeply hooked anterior point of the dorsal fin. The left side of the point of this dorsal fin-hook is white.

The lower right or blind side is everywhere absolutely of the same color as the upper, left or eyed side. This flounder is *bilaterally colored*. It is what the fishermen called a "black belly,"—i.e., a flatfish having



Fig. 5

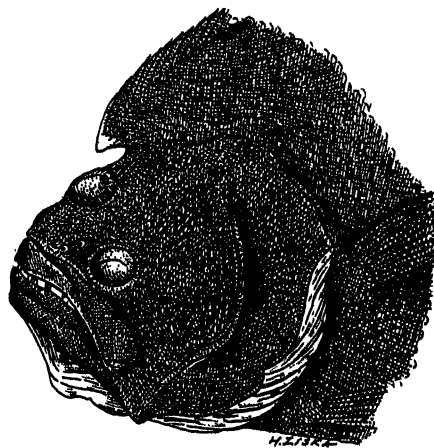


Fig. 4

Right and left sides of the head of a totally ambicolorate southern flounder, *Paralichthys lethostigma*.

Fig. 4. Note the right eye barely across the dorsal crest and the overhanging hook (white at the point) of the dorsal fin.

Fig. 5. Note that the blind side of this head is colored exactly like the eyed side. The rotated eye is still visible, and the point of the dorsal fin-hook is white.

Specimen from Mr. F. E. Firth.

the lower surface colored like the upper side. As explained no figure of the lower surface can be given, but the drawing of the lower side of the head (Fig. 5) when contrasted with that of the upper side shows the same coloration, the same hook to the dorsal fin (with its whitish point), and the right eye still shows above the dorsal crest.

A front view of the head of this fish (Fig. 6) shows that, in front of the dorsal fin and its hook, the head instead of being in line with the dorsal fin is twisted slightly to the left. This seems to be the rule. At any rate the other two fish described in this paper show the same thing.

This is certainly due to the slight twisting that the skull and other parts have undergone in the course of the migration of the eye. Note that the right edge of the dorsal fin-hook, the right edge of the rotated eye, the right nasal openings, and the right canine teeth are in the same plane. This figure is, I believe, the first to show in head-on view the eye and dorsal fin peculiarities of such a flatfish.

It should be emphasized that these three ambicolorates form a fine series. Fish no. I is only partially (about  $\frac{3}{5}$ ths) ambicolorate below and has no head anomalies. No. II has the whole under body and at

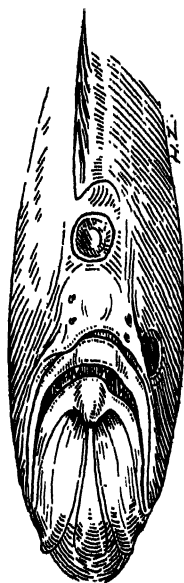


Fig. 6. Head on view of the totally ambicolorate flounder to show the relative positions of snout, rotated eye and hooked dorsal fin.

Sketched from fish No. III.

least  $\frac{1}{3}$ rd of the head dark like the upper side, and has the incompletely rotated eye and the hooked dorsal fin. Finally fish no. III is bilaterally colored in maturity as in prelarval-hood but, instead of having bilateral eyes, it has the rotating eye almost cyclopean and it has the accompanying hooked dorsal fin.

No attempt will be made here to explain the anomalies described herein. This will be done later in two general papers in which the phenomenon of ambicoloration, both partial and complete, will be gone into thoroughly.



# AMERICAN MUSEUM NOVITATES

Number 898

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

Dec. 31, 1936

## A NEW FLYING SQUIRREL FROM HONDURAS

BY GEORGE G. GOODWIN

In a preliminary study of an interesting collection of mammals recently obtained from C. F. Underwood in Western Honduras, I find a new flying squirrel, which seems to represent a hitherto undescribed geographical race. It is here named in honor of the collector, who for many years has been making valuable contributions to the knowledge of the fauna of Honduras.

### *Glaucomys volans underwoodi*, new subspecies

#### Underwood Flying Squirrel

TYPE.—No. 123372, Amer. Mus. Nat. Hist.; male adult; Zambrano, Tegucigalpa, Honduras, a village on the main road to Lake Yojoa and the north coast, about halfway between Tegucigalpa and Comayagua; altitude 4500 feet; March 21, 1935; collector, C. F. Underwood.

Only one specimen known—the type. Skin in good condition, skull with zygomatic arches and base of brain-case damaged.

GENERAL CHARACTERS.—Similar to *Glaucomys v. goldmani*, from Chiapas, Mexico, but color grayer and less rusty brownish; white on nose more restricted; post-auricular spots more extensive and paler. Skull larger.

DESCRIPTION.—Upper parts of head, nose and body light sayal brown; sides of face smoke gray mixed with fuscous; ring round eye fuscous black; area between eye and ear fuscous black shading into gray on cheeks and sides of head below ear; sides of neck joining post-auricular spot which extends over posterior half of ear pale pinkish buff; outer side anterior half of ear sparsely covered with fine fuscous hair; sides of nose creamy white; upper surface of flying membrane black finely washed with sayal brown; hind feet fuscous, toes wood-brown; forefeet and toes buffy white; tail above, snuff-brown, below, slightly lighter than pinkish buff; under parts of body, throat, chin and under side of fore limbs creamy white lightly washed with pinkish buff; under surface of membranes and inner side of thighs between pinkish buff and pale pinkish buff.

SKULL.—Characters much the same as in *Glaucomys v. goldmani* but larger, with longer palate and broader rostrum; the greatest breadth of the rostrum is largely in the nasals; incisors slightly broader than *G. v. goldmani*, but molariform teeth are about the same.

MEASUREMENTS.—Skin, measured in the field, length of head and body, 136 millimeters; tail vertebrae, 105; hind foot, 29; ear, 16. Skull, greatest length, 35.7; least interorbital breadth, 7; least postorbital breadth, 9; length of nasals, 10.4; greatest breadth of nasals, 4.7, at base, 3.3; width of rostrum, 6.5; palatal length, 18.1; maxillary tooth row, 6.75.

All of the forms of *Glaucomys volans* are closely allied and, although widely separated geographically, *G. v. underwoodi* is not very different from forms that occur in the United States. It requires comparison only with *G. v. goldmani*, from Chiapas. Compared with *G. v. goldmani* it is somewhat similar in size and color, but the upper parts are grayer and less rusty brownish. The under surface of the membranes and inner sides of the thighs in *G. v. underwoodi* are between pinkish buff and pale pinkish buff. In *G. v. goldmani* these parts are near ochraceous buff. The under side of the tail in *G. v. underwoodi* is a slightly lighter pinkish buff than in *goldmani*. The skull in *G. v. underwoodi* is larger and longer with longer palate and broader rostrum than in *G. v. goldmani*. Most of these characters appear to be beyond the usual range of individual variation in this group of flying squirrels.

Colors are from 'Color Standards and Color Nomenclature,' Ridgway, 1912.

I am indebted to the Bureau of Biological Survey for the loan of comparative material and to Major Goldman for comparing this specimen with the type of *Glaucomys v. goldmani*.







